Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

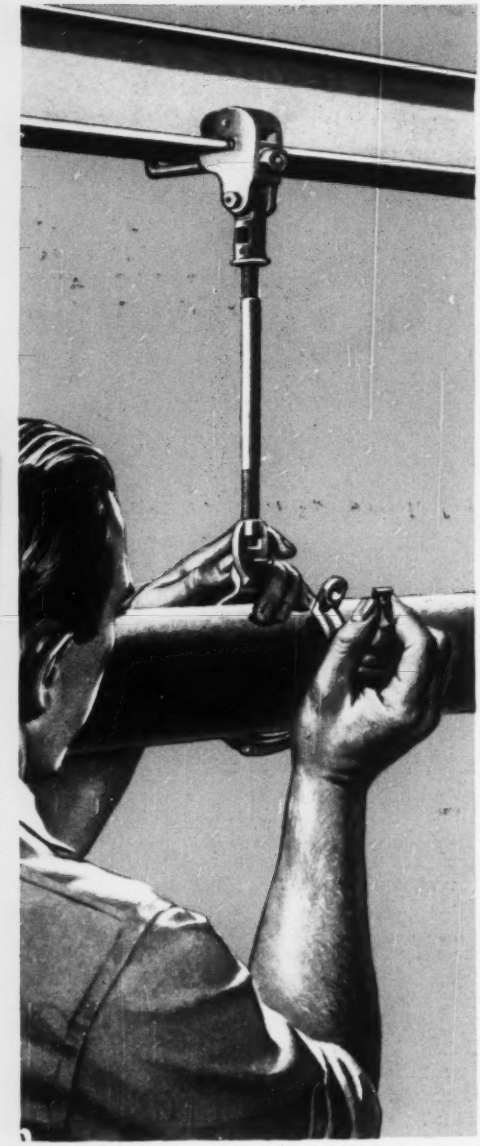
FEBRUARY ★ 1950

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

Page 103—Journal Section of the American Society of Heating and Ventilating Engineers

Air conditioning boosts church attendance—see page 73

Power Piping Practice 77
Chart Aids Stoker Operation 84
Practical Piping Problems 98
Complete Contents of This Issue 5



Right for the job and priced right!

There's nothing sensationally "tricky" about this pipe hanger. It's just the most practical and inexpensive way of hanging pipe for a great many jobs. Complete assembly includes a split pipe ring and socket, rod, extension piece and universal I-beam clamp. Available for pipe from ½" to 8", for loads from 75 to 1510 lbs.

It is well worth remembering that a good piping job is too important to jeopardize with improvised or inadequate pipe hangers and supports. You can get from Grinnell just the right pipe hanger for any job within the shortest possible time at the lowest cost consistent with quality.

Grinnell has the most complete line of pipe hangers, extensive manufacturing facilities, warehouses across the country, and jobbers in almost every city and town.

UNIVERSAL SIDE I-BEAM MALLEABLE IRON CLAMP (Fig. 225) . . . Used on American Standard I-beams as well as wide flange beam sections. One of 10 different Grinnell I-beam clamps to meet varying specifications.

MALLEABLE IRON EXTENSION PIECE (Fig. 157) . . . Bolts into Universal Side I-beam Clamp (Fig. 225) and other malleable iron clamps to receive hanger rod. Provides for adjustment of rod.

MALLEABLE IRON SPLIT PIPE RING AND SOCKET (Fig. 107R)...Once hanger rod is turned to proper adjustment and the attached half of the ring is snugged against the pipe, the other half of the ring is swung up into position and bolted. For 13 pipe sizes, ½" to 8", for loads from 75 to 1510 lbs.

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Grinnell Company, Inc., Providence 1, R. I. Warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

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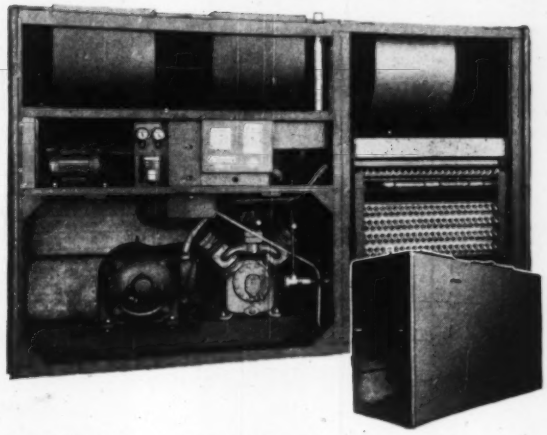

from drying up your air conditioning profits

New York's right in the midst of one of the nation's most serious water shortages. Last year it was California that was dangerously dry. The same can happen in other sections.

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Don't let the threat of water shortages rob you of profitable air conditioning business. Choose Refrigerated Kooler-aire . . . the one air conditioning plant that *saves* water.

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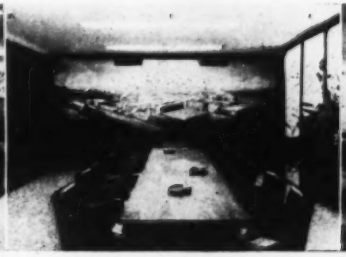
Mohawk Carpet Company recently opened their swank new showrooms in Manhattan, heart of the drouth area. Refrigerated Kooler-aire does the cooling job.



Mohawk directors meet in this beautifully appointed room, which features comfortable chairs, restful lighting and the supreme comfort of R-K conditioning.

Customers stay longer, buy more . . . merchandise stays cleaner and in better condition . . . thanks to automatically controlled temperature and humidity furnished by Refrigerated Kooler-aire.

HEATING, PIPING & AIR CONDITIONING, published monthly by Keeney Publishing Co., 6 N. Michigan Ave., Chicago 2, Ill., U.S.A. Yearly subscription rates U.S. and Possessions, $3.00; Canada, Cuba, Mexico, Central and South America, $4.00. Other countries, $6.00. Current copies U.S. and Possessions, 35 cents. Back numbers, 60 cents. January 1950 issue, $1.50 per copy. February, 1950, Vol. 22, No. 2. Entered as Second Class Matter May 18, 1929, at the Post Office at Chicago, Ill., U.S.A., under the Act of March 3, 1879. Additional entry at Milwaukee, Wis.

Combating a 12,000 gpm Corrosion Threat in the

"AIR-CONDITIONED CITY"

To completely air-condition the 1000-room Rice Hotel at Houston, Texas, 12,000 gallons of water per minute must be circulated between the engine room and the giant cooling tower on the roof of the hotel garage, 700 feet distant. To combat the inescapable corrosive attack, the engineers used Byers Wrought Iron plates in fabricating the 18-inch pipe which handles the flow. A substantial quantity of Byers Wrought Iron pipe was also supplied for cooling and condenser water lines within the hotel building.

Houston, which claims more air-conditioning than any other city in the world except Washington, D.C. calls itself the "Air-Conditioned City". This concentration of installations gives engineers and users ample opportunity to determine the worth of various materials. It is significant that wrought iron appears in practically every specification.

The durability of wrought iron in services like these comes from the unusual character of the material. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack. The fibers also anchor the initial protective scale, which shields the underlying metal just as a scab protects a wound.

If you are contemplating any air-conditioning installations, or are concerned with the maintenance of any existing systems, you will find some helpful information on the use of wrought iron in our bulletin, WROUGHT IRON IN REFRIGERATION, ICE SKATING RINKS AND AIR-CONDITIONING SYSTEMS. Ask for a complimentary copy.

J. RUSS BATY, Architect on Hotel Garage; REG F. TAYLOR, Consulting Mechanical Engineer; CHAS. G. HEYNE & CO., Mechanical Contractors on Air Conditioning; KANE BOILER WORKS, Fabricators of 18" pipe; O. W. ROSIN, Chief Engineer, Rice Hotel.

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Published monthly by the Keeney Publishing Co., 6 North Michigan Avenue, Chicago 2, Illinois. Telephone: State 2-6916. Subscriptions: U.S. and possessions, $3.00 per year; Canada, Cuba, Mexico, Central America, South America, $4.00 per year; other, $6.00, Current copies, U.S. and possessions, 35c each; back copies, 60c each. January 1950 issue, $1.50 per copy. Member Audit Bureau of Circulations and Associated Business Publications, Inc.

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FEBRUARY 1950 . . . Vol. 22, No. 2

The Editor's Pages (news, notes, and comment)..... 65

"Open for Discussion" (a regular feature)..... 69

Storage Air Conditioning System Boosts Attendance at Big Church, by David C. Pfeiffer..... 73

Power Piping Practice—1900-1950, by A. G. Christie..... 77

The Physical Side of Comfort, by A. C. Menke and C. L. Ringquist 81

Data Sheet—Chart Aids Stoker Operation and Helps to Prevent Smoke, by Charles J. Lehn..... 84

How to Air Condition Two Executive Offices, by Joseph M. Aikman 86

Smog . . . the Killer (review by Allen D. Brandt)..... 88

First Aluminum Gas Line Installed..... 89

Water, Water Everywhere . . . But Not Enough..... 90

How to Space Pipe Supports, by Theodore E. Bridge..... 92

Question of the Month—Does Antifreeze in a Heating System Affect Heat Transfer?..... 97

Practical Piping Problems, by Robert C. Soronen—Flash and Blowoff Tanks..... 98

Explains Workings of Office Building..... 100

Sam Lewis' Page—Converting One of Two Boilers to Gas Firing 101

Sees Big Demand for Heating, Piping, Air Conditioning..... 102

Equipment Developments..... 151

Who's What..... 165

New Books and Reports..... 174

Meetings and Conventions..... 177

Recent Trade Literature..... 178

Index to Advertisers..... 188

Heating, Piping & Air Conditioning is indexed regularly by Engineering Index, Inc.

Journal Section of the American Society of Heating and Ventilating Engineers

Baseboard Radiation Performance in Occupied Dwellings, by G. S. MacLeod and C. E. Eves..... 103

Fitting Losses for Extended-Plenum Forced Air Systems, by H. H. Korst, N. A. Buckley, S. Konzo, and R. W. Roose..... 111

1949 Annual Report of Committee on Research..... 119

1950 Officers..... 127

ASHVE Meeting, Exposition at Dallas..... 128

Summary of Chapter Meetings..... 129

Candidates for Membership..... 133

Officers, Council, and Committees..... 135

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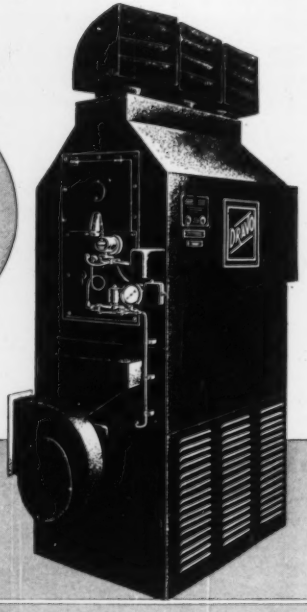

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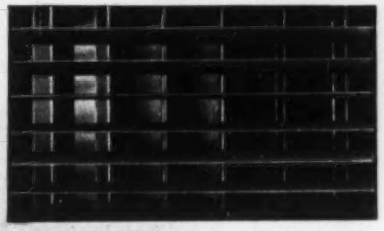

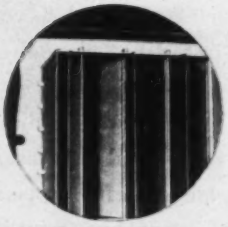

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Refrigeration and Air Conditioning

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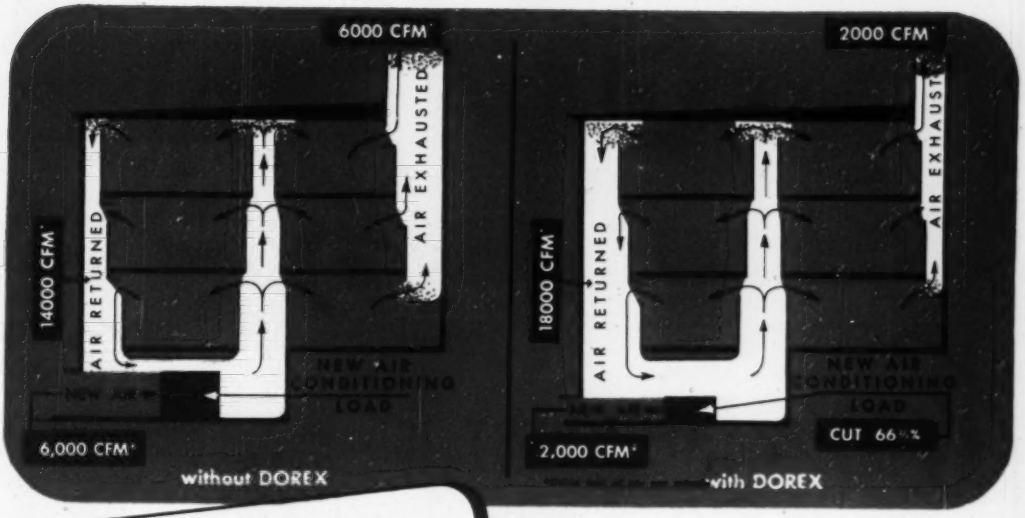

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Briefly, here's the answer: Every 1,000 cubic feet of conditioned air that is exhausted per minute costs over $200.00 a year. If, for instance, you are exhausting 6,000 CFM, you are, in effect, throwing out $1,200.00 worth of conditioned air.

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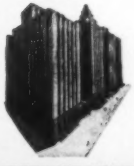

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15% Interest and Amortization on $1,000.00		$150.00
Power (Average 1.5 tons x 1 KW x 1200 hrs. x $0.02)		36.00
Oil (Average 0.47 gals. x 2600 x .08)		98.00
Water plus pumping cost (based on Cooling Tower)		10.00
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15% Interest and Amortization on $160.00		$ 24.00
Carbon Reactivation Cost (once per year)		30.00
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Net annual savings per 1000 CFM $240.00

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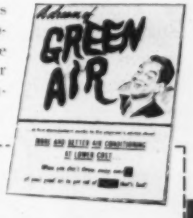

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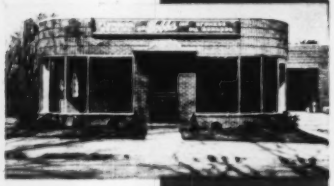

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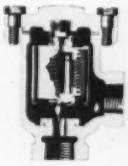
A THERMOSTATIC



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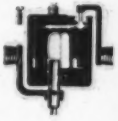
Ball float allows continuous discharge without shock to temperature controls and other instruments. Automatic thermostatic by-pass takes care of air and gases without steam waste. All pressures up to 200 psi. Bulletin No. 450.

C BUCKET



Intermittent, but very rapid—can handle large volumes of condensate. Air goes out with the condensate. All parts attached to cover provide easy inspection. Straight-through connection makes installation easy. Integral strainer inside. Standard sizes to 250 psi. Forged steel types to 900 psi, and superheat. Bulletin No. 350.

D LIQUID EXPANSION

A low cost combination of trapping and approximate temperature control. Ideal for outdoor tanks and lines and other points where condensate cannot be returned. In other forms, used as combination trap and control for wash tanks, food equipment, etc. Catalog Nos. 250 and 550.

APPLICATION	1st CHOICE	2nd CHOICE
Process Tanks, small	A	C
Process Tanks, large	B	C
Dryers, Coil Type	B	A
Dryers, Fan Type	B	C
Drying Tumblers	B	A
Water Heaters	B	C
Preheaters, Fuel Oil	B	C
Rotating Cylinders	B	B
Slashers	B	B
Dry Cans	B	B
Flat Work Ironers	C	B
Presses, Laundry	C	A
Stocking Forms	C	A
Presses, Plastics	C	A
Presses, Platen	C	A
Evaporators	B	C
Steam Lines Outdoors, small	A	D

Ask for Bulletin No. 1600 "Selecting Steam Traps"

267

SARCO SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

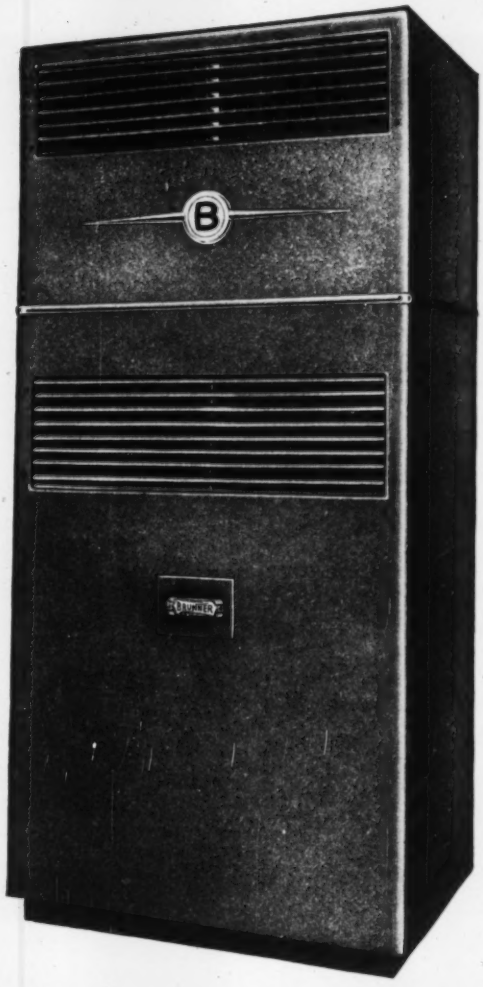
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

BRUNNER SINCE 1906 **AIR CONDITIONING** builds business

WHAT'S KEEPING YOU AWAY

from Air Conditioner Profits?



PRODUCT? Brunner self contained floor type room air conditioners are available in 4 popular sizes—3, 5, 7½ and 10 ton. Completely Brunner built...backed by 44 years of engineering "know how." *By every standard of comparison an outstanding product worthy of your confidence.*

INVOLVEMENT? Packaged air conditioning is simple to sell, install and service. No involved technical knowledge is required. Recommendations are determined through a few easily figured facts. Packaged air conditioning is a natural part of any refrigeration and appliance business.

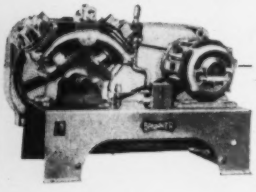
SALES HELP? Brunner field-sales engineers are so located across the country as to be readily available to help on every occasion when called upon. Brunner advertising to "users" in many fields has paved the way to recognition and acceptance of Brunner as the top value in air conditioning.

MARKETS? All around you! Practically every business depending upon store traffic, wants and needs air conditioning. The opportunities are legion. The Brunner field man will show you how to contact and close sales.

PROFIT? Brunner Air Conditioning builds business ...yours and your customer's. Don't let this extra income pass you by. Write or wire for a Brunner representative to spread the facts before you. You can't miss recognizing the superiority of Brunner Air Conditioners as a product and as a *new business* opportunity.

BRUNNER SINCE 1906 **AIR CONDITIONING**

- **Self Contained 3 HP. to 10 HP.**
- **Remote Type 5 HP. to 75 HP.**



BRUNNER MANUFACTURING CO., Utica 1, New York, U.S.A.

REFRIGERATION CONDENSING UNITS by BRUNNER SINCE 1906

AIR AND WATER COOLED MODELS—*a size and type for every purpose...* **¼ HP. TO 75 HP.**

first

AND THE LAST WORD
in forged steel fittings for all industries . . .

CARBON STEEL
Low Sulphur, Low Phosphor
High Tensile, High Weldability

ALLOYS
Stainless types 304–316–347
Chrome Moly–Carbon Moly–
Chrome Carbon Moly–Monel
Special alloys for Low Temperatures

W-S on Forged Steel Fittings, produced in commercial quantities—has been and still is the last word in dependable, trouble-free screw end and socket weld fittings service for ALL INDUSTRIES. Here's Why:

Reflected in the manufacture of every W-S *Forged* Fitting is a specialized knowledge of its end use by a particular industry. Beginning with selection of the right material from a wide choice of carbon and chrome-alloy steels, each W-S *Forged Steel* Fitting is tailor-made for a specified application:

Is high temperature, high-pressure STRENGTH a problem? W-S has been supplying intermediate alloy fittings to the power industry for many years. Want CORROSION RESISTANCE? W-S provides a full range of the popular stainless grades for all chemical processing requirements. Need PROTECTION against contamination and discoloration? Many food and drug processing plants use W-S 18-8, type 304, for full assurance of SANITATION . . . have for years. Plagued by INTERRUPTED SERVICE due to fittings failure under conditions of shock, vibration, and erosion? Industry after industry . . . and commercial and institutional users as well . . . have discovered the long-range ECONOMY of forged, life-of-the-system joints, as compared to any other kind.

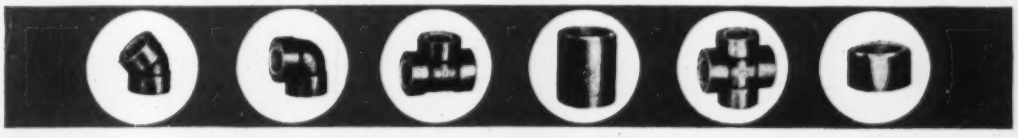
Be sure that you have the right answer to your next fittings problem . . . before it arises: write for W-S Bulletin A-3, today.

SOA

WATSON-STILLMAN ROSELLE, NEW JERSEY *Established 1848*

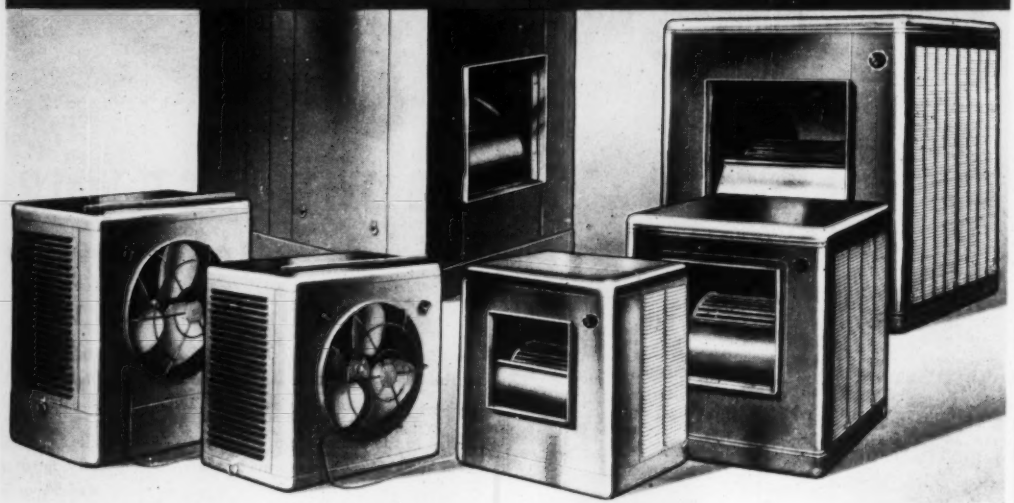
Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

SOLD THROUGH LEADING DISTRIBUTORS



HERE'S UTILITY FOR 1950

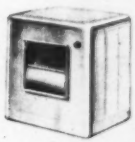
The Most Complete Cooling Line at New Lower Prices!



The 1950 line of Utility Coolers is America's most complete line. Think of it! Six styles, over 24 models . . . prices start at $33.95 list on fan coolers . . . $79.25 list on duct-type coolers. Sizes range from 800 CFM to over 12,000 CFM. Stock up now for greater profits in 1950.

TRAILER MODEL Series. Low-cost, efficient cooling for smallest rooms. Fits in window—flanged to hook on sash.

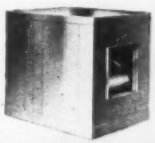
FAN MODEL Series. Deluxe fan cooler with built-in re-circulating pump. Fits in window—top flange hooks on lower sash.



DUCT COOLER Series. 10" and 12" blower wheels. Especially designed kits for window installation.

DUCT COOLER Series. 7 models. 16" to 19" diameter blower wheel, for small and medium-size homes.

DUCT COOLER Series. 6 models. From 22" to 26" blower wheel. For large homes and commercial installation.



"ROTO-SPRAY" Series. A complete line of glass pad rotary spray washer-type coolers for particular needs.

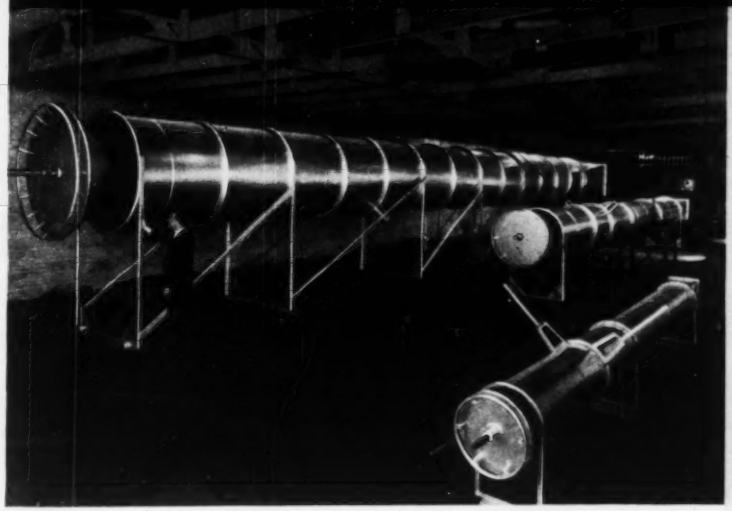
HOW TO DOUBLE COOLER PROFITS IN 1950

Guaranteed Air Delivery

Utility's complete line . . . and lower prices, are backed by Utility's intensive consumer advertising. Utility is easier to sell than ever, to a larger market than ever before. Feature the Utility line and double your profits!

Guaranteed Cooler Profits

LOOK HOW UTILITY PUTS SCIENCE TO WORK–SETS THE PACE FOR THE COOLING INDUSTRY



These wind tunnels, like all other equipment illustrated on this page, are the same equipment used by the Bureau of Standards. Every Utility Cooler is tested in accordance with A.S.H.V.E. test codes.

SOUND LEVEL meter tests for quiet operation . . . prevents noise nuisance.

THE INDUSTRY'S most efficient production techniques assure high, uniform quality.

GISHOLT Dynetric Balancer checks *every* Utility Blower; assures perfect balance.

New "Seal-Bonded" painting for corrosion prevention.

Inside Cooler Bottom is Asphalt-Sealed for corrosion prevention.

Blower Assembly zinc-chromated and "Seal-Bonded" for corrosion prevention.

New Blower Mountings give quieter operation, longer life, less vibration.

All Fan Coolers have sealed bearing motors.

All models up to 16" wheel diameter are COMPLETELY ASSEMBLED . . . ready to plug in.

Factory pre-tested and inspected . . . Guaranteed one year!

EXCLUSIVE TRIED-AND-TRUE UTILITY FEATURES

1. Water-resistant Pump Motor Housing. Fully shielded against moisture.
2. Pad Rack Positioned for Positive Wetting Action. Water grooves at front of pads.
3. Uniflow Trough. Has water grooves which distribute water evenly over entire width of filter pads.
4. Uniflow Orifice, breaks up surface tension of water. Forces continual flow.
5. Uniflow Meter overcomes gravity by building up internal pressure head. Assures even water distribution even when tilted.
6. Micrometer Adjustment Hose Clamp, makes it easy to install recirculating pump.

PLUS . . . *Pure Aspen Filter Pads . . . Patented No-Sag Pad Racks . . . Adjustable Pitch Motor Pulley*

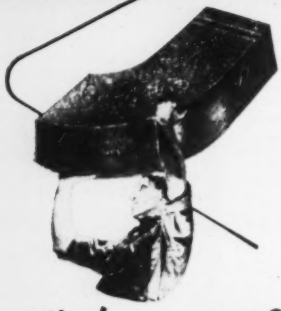
Dynamically-balanced oversize blower wheels for greater air deliveries at lowest operating cost.

ORDINARY WHEEL — UTILITY WHEEL

THERE'S PROFIT UTILITY TRADE MARK **IN THE AIR!**

4851 SOUTH ALAMEDA STREET • LOS ANGELES, CALIFORNIA

Manufacturers of gas-fired heating equipment and Gaffers and Sattler and Occidental Gas Ranges



How's your stock?

If you work with sheets, it will pay you to ask your jobber for those bearing the familiar U·S·S Trade-mark. It is your guide to the finest quality . . . and your customers' assurance that you are using the best sheets available.

The brand most in demand...

● Jobs done with U·S·S Galvanized Steel Sheets enjoy a public acceptance that's second to none! They look better. They last longer. But, U·S·S Galvanized Steel Sheets are more than *prestige-builders* for your shop. They enable you to speed up shop practices because their superior fabricating and forming characteristics make them easier to handle. Uniform in surface, flatness and ductility, U·S·S Galvanized Steel Sheets are especially processed with a tightly adhering coating of zinc. It's easy to obtain tight, neat connections with soldered, or riveted seams when you do the job with U·S·S Galvanized Steel Sheets.

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH & CHICAGO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

U·S·S STEEL SHEETS

9-1816

UNITED STATES STEEL

576 families live in this modern housing development in Queens, N. Y. The entire project is heated by a B & G Hydro-Flo System supplied by sixteen boilers in eight boiler rooms.

NO JOB TOO BIG OR TOO SMALL FOR B&G *Hydro-Flo* HEATING

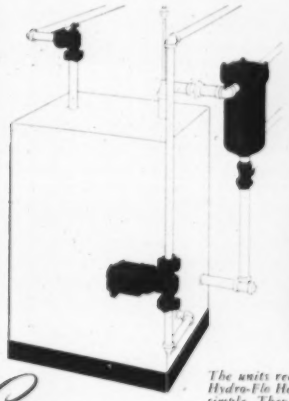
It is not just happenstance that the popularity of B & G *Hydro-Flo* Heating grows steadily, year after year. You find this *forced hot water system* in buildings of every size and character, simply because it offers completely outstanding advantages.

B & G *Hydro-Flo* Heating is amazingly economical in operation—delivers years of trouble-free service—and provides the kind of comfort *obtainable only with controlled radiant heat. And B & G Hydro-Flo Heating is competitive in price with heating systems worthy of the name!*

The close temperature regulation possible with *forced hot water* means that fuel is never wasted in supplying unnecessary heat. Indoor temperature is maintained by accurate controls at the comfort level, regardless of how sharply the weather changes.

Whether radiators, convectors, baseboards or radiant panels are used, B & G *Hydro-Flo* Heating sets the pace for efficiency, low maintenance and comfort.

This modest residence enjoys the comforts of controlled radiant warmth from a B & G Hydro-Flo System.



The units required for B & G Hydro-Flo Heating are few and simple. They can be applied to any hot water heating boiler, whether oil, gas or stoker fired.

Best for any kind of radiation

BELL & GOSSETT *Company*

Dept. BJ-5, Morton Grove, Ill.

* Reg. U. S. Pat. Off.

Going! Going! Gone! Skyscraper air conditioning has progressed from large ducts to small, until now it requires no ducts at all—only ordinary water pipe.

Skyscraper air conditioning without ducts...

Ductwork—once the "necessary evil" of skyscraper air conditioning—may still be "evil," but no longer is necessary. Revolutionary new UniTrane air conditioning eliminates entirely the need for ducts.

UniTrane is designed for the largest skyscraper, and it fits small multiroom buildings, too.

It is a unit system, but there is no compressor or other complicated apparatus in the unit. Simple piping, similar to hot water heating—illustrated above—carries warm water to the unit for winter heating and chilled water for summer cooling.

UniTrane may be used for either new or remodeling work. It is so simple and so flexible that it can be installed a bit at a time if desired. It is practical and economical to make the original UniTrane installation for straight heating only, with cooling to be added later. Or units may be installed and operated in a wing, a floor, or a zone of a building without disturbing other existing equipment.

Type MC UniTrane provides individual room control of temperature, moisture, and ventilation. All air is filtered. There is no mixture of air between rooms or corridors.

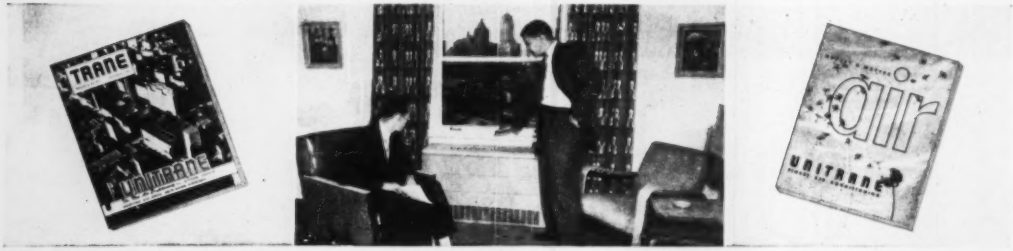
Each room has its own year-around air conditioning system, all contained in a compact package that fits under the window.

Ask the Trane sales office in your area for a copy of "Merely a Matter of Air," which covers the ABC's of skyscraper air conditioning in general, from bulky central systems to ductless UniTrane.

THE TRANE COMPANY...LA CROSSE, WIS.

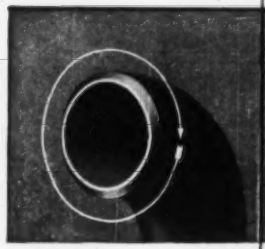
Manufacturing Engineers of Heating, Ventilating and Air Conditioning Equipment—Unit Heaters, Convector-radiators, Heating and Cooling Coils, Fans, Compressors, Air Conditioners, Unit Ventilators, Special Heat Exchange Equipment, Steam and Hot Water Heating Specialties ... IN CANADA, TRANE COMPANY OF CANADA, LTD., TORONTO.

UniTrane room units are beautifully styled for under window installation in offices, hotels, hospitals and other multiroom buildings. Data bulletin DS-420 is for architects and engineers . . . "Merely a Matter of Air" is for the non-technical reader.

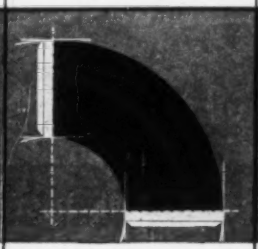


What do YOU want in a welding fitting?

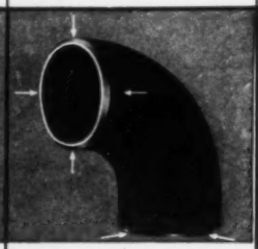
These *PLUS* features are combined in WeldELLS and other Taylor Forge Welding Fittings.



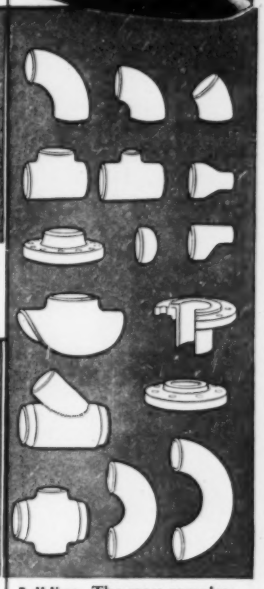
Seamless—No question about soundness in a fitting that is forged and formed seamless.



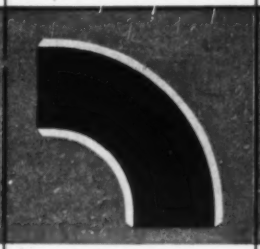
Tangents—Keep weld away from zone of greatest stress—simplify lining up.



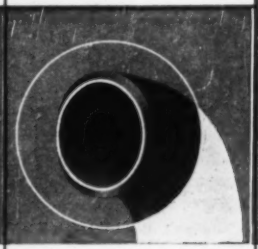
Precision quarter-marked ends—Expedite layout; insure accuracy. A constructive refinement.



Complete identification—Permanent type; saves time; prevents errors.



Wall thickness never less than specification minimum—Assures full strength and long service life.



Machine tool beveled ends—Provides *the best* welding surface; accurate bevel and land.

Full line—The most complete line of welding fittings and forged steel flanges in the world — greatest range of types, weights, sizes.

Taylor Spiral-Weld Pipe is again available, quickly, in a broad range of sizes and thicknesses. Coupon brings new Spiral-Weld Pipe Bulletin 493.

510-0250

TF TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS General Offices & Works: P. O. Box 485, Chicago 90, Ill. • Eastern plant: Carnegie, Pa. • Western plant: Fontana, Calif. • District Offices: New York, Philadelphia, Pittsburgh, Houston, Los Angeles, San Francisco, Chicago.

☐ Please send new catalog 484 covering welding fittings and forged steel flanges.

☐ Send new Bulletin 493 covering Taylor Spiral-Weld Pipe and related fittings.

Name_____

Position_____

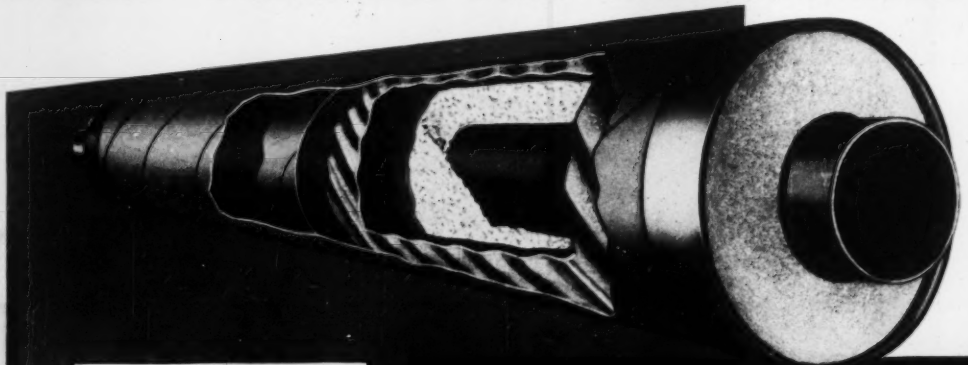
Company_____

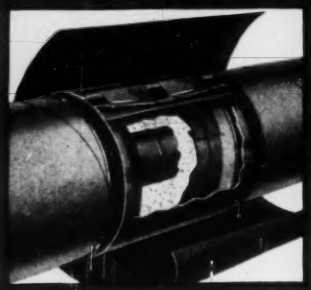
Street Address_____

City_____ Zone_____ State_____

510-0250 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

ONLY RIC-WIL GIVES YOU ALL THESE ADVANTAGES





- HIGH EFFICIENCY INSULATION
- PREFABRICATED AND SEALED SECTIONS
- FLEXIBILITY IN INSTALLATION
- PREFABRICATED ACCESSORY UNITS
- DEPENDABLE LONG LIFE

When planning your next job, specify Ric-Wil Prefabricated Insulated Piping and take advantage of these features that lower installation, operating and maintenance costs.

Prefabricated to fit your specific piping system planning, they are constructed with "built-in" endurance and high efficiency insulation. In addition, Ric-Wil Engineering service is available for planning and field installation assistance.

Forty years of designing, engineering and production experience insures reliable and lasting operation of Ric-Wil Piping Systems.

Upon request, our representative will provide detailed Ric-Wil technical information as related to your specific problems.

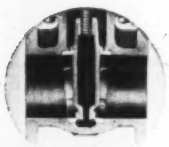
For full technical information on Ric-Wil Insulated Piping Systems, call or write the Ric-Wil office nearest you or Dept. 1-F in Cleveland, Ohio.

RIC-WIL

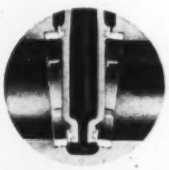
INSULATED PIPING SYSTEMS

OVERHEAD — THE RIC-WIL COMPANY · CLEVELAND, O. — UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS



Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



Seat Rings of end-seated type are screwed into the body.

Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.

WALWORTH

iron body gate valves

with screwed or flanged ends

... 8 Outstanding Features

For complete information on these new Walworth Iron Body Valves, see your local Walworth distributor, or write for bulletin 106.

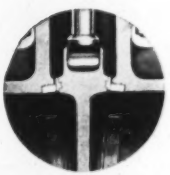
Brass Liner on Glands assures greater resistance to corrosion and scoring.

WALWORTH

valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

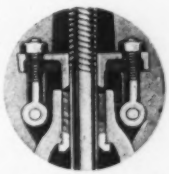
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.

Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

Nothing heats better than Modine Convector Radiation . . . NOTHING LOOKS MORE BEAUTIFUL IN A BEAUTIFUL ROOM

To find out why the new Modine Convector is the *better* way to heat apartments, homes, schools, offices or hospitals, call your Modine Representative. He's listed in the "Where-to-Buy-it" section of your phone book. Ask to see a sample, or write direct. Modine Mfg. Co., 1509 Dekoven Avenue, Racine, Wisconsin.

Send for New Modine Convector Catalog Today!
Special 1-Pipe Steam Convector Bulletin Also Available.

Design and Mechanical Patents Pending

Modine
CONVECTORS

R-1048

CALL YOUR SPANG CW DISTRIBUTOR WHEN THEY WANT...

JUNE SIDEWALKS IN JANUARY

● Safety and convenience are the reasons why building owners want June sidewalks in January. Dependable performance is the reason why contractors use Spang CW Pipe in snow melting systems. That's because Spang CW is a proved material in closed, hot water heating systems.

Spang CW Pipe can be used with equal effectiveness under either concrete or asphalt. And you'll find that no kid glove care is required to make strong, leak-proof welded joints. What's more, Spang CW is a glutton for punishment. It can be bumped hard, stepped on or run over with a loaded wheelbarrow without being crushed, broken or harmed in any way.

There are other advantages for both you and your customers when you use Spang CW Pipe in any piping job. And there are advantages in doing business with your friendly Spang CW Distributor. Next time you need pipe or piping materials, call him. You'll see what we mean.

SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICES: PITTSBURGH, PA.

District Sales Offices: Atlanta; Boston; Chicago; Detroit; Houston; Los Angeles; New York; Philadelphia; Pittsburgh; St. Louis; San Francisco

SPANG

CW

QUALITY *that is recognized wherever pipe is used*

WAGNER MOTORS
...The choice of leaders in industry

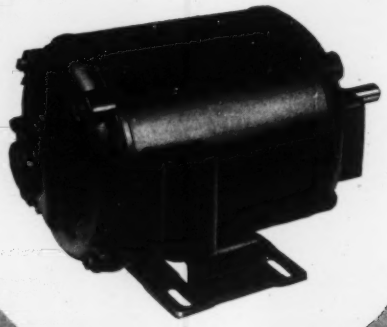
Here's what you get in the WAGNER *Type RA* MOTOR...

the most simplified design to provide—

repulsion start

HIGH STARTING TORQUE . . . for quick, easy starting and smooth acceleration.

LOW STARTING CURRENT . . . to minimize light flicker when motor starts.

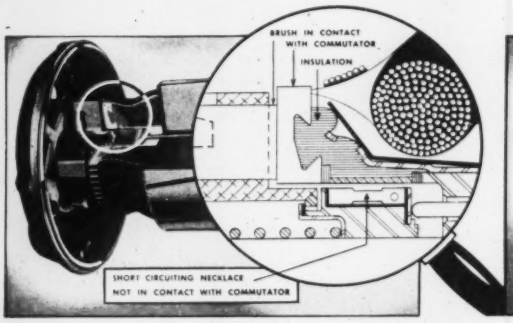


induction run

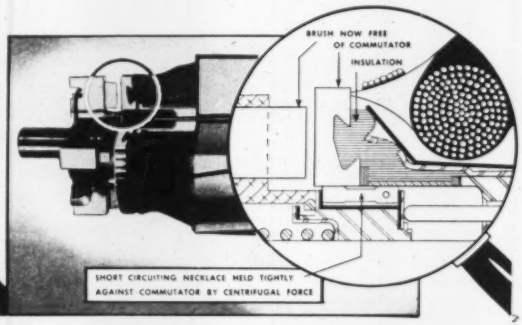
HIGH OPERATING SPEED . . . constant at all operating loads, even under overload.

FLAT EFFICIENCY CURVE . . . over a wide operating range.

Pioneered by Wagner more than half a century ago, the repulsion-start induction single phase motor is truly industry's "general purpose" motor because it combines the best features of two types of motors: the repulsion motor during the starting period and the induction motor while running at rated operating speeds. Today, the Wagner Type RA offers the most simplified, trouble-free design available, and is still the standard by which all other single phase motors are judged. In the Wagner Type RA Motor you get low upkeep cost, minimum servicing, freedom from vibration and noise, and years of reliable service. Shown below are the basic principles of operation of this motor. Bulletin MU-185 gives complete details. Write for a copy.



Starting period—Short-circuiting necklace is not in contact with commutator bars. A governor spring holds barrel in starting position. Brush assembly completes selected circuits enabling motor to start as a repulsion motor.


BRUSH NOW FREE OF COMMUTATOR
INSULATION
SHORT CIRCUITING NECKLACE HELD TIGHTLY AGAINST COMMUTATOR BY CENTRIFUGAL FORCE

Running period—Governor weights (actuating pushrods) have forced spring barrel forward until short-circuiting necklace connects commutator bars to short-circuiting ring, forming a "squirrel cage" to permit operation as an induction motor.

Wagner Electric Corporation EST. WE 1891

MM-6

WAGNER ELECTRIC CORPORATION
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 29 PRINCIPAL CITIES

demand DETROIT CERTIFIED CONTROLS

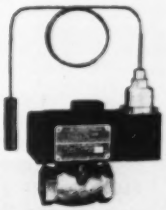
TIMED CYCLING brings you:

1. Uniform room temperature—controlled within a fraction of a degree.
2. Elimination of the waste and discomfort of over and under heating.
3. Greater fuel economy.
4. Automatic adjustment of heating to all existing influences, such as outside temperature, wind direction and velocity, solar radiation, etc.
5. Truly fine heating—geared to the weather.

Comfort is Your Business— and **"TIMED CYCLING"**

brings your customers comfort they never dreamed possible!

Timed Cycling is a sales natural—because it virtually eliminates the many heating discomforts your customers had accepted as inevitable. This remarkable thermostatic development automatically adjusts the operating periods of the burner—holding room temperature constant within a fraction of a degree regardless of icy winter winds, outside temperature or solar radiation. Pioneered, developed and perfected by DETROIT engineers, the *Timed Cycling* thermostat, in combination with other superior DETROIT controls, provides the finest in heating control systems—far surpassing other systems now in use. Take advantage of this marvelous sales opportunity by telling your customers about this latest advance in heating control. It's another DETROIT achievement—bringing greater comfort to your customers and greater profits to you.



No. V-574-FW "Bi-flex" Gas Valve—An electrically operated valve with mechanical limit control which is independent of electrical circuit. Valve closes automatically if furnace or boiler temperature exceeds limit setting of valve. Step-opening feature assures quiet ignition. Controlled by No. 411 "Timed Cycling" Thermostat. Available for steam, hot water and warm air systems.

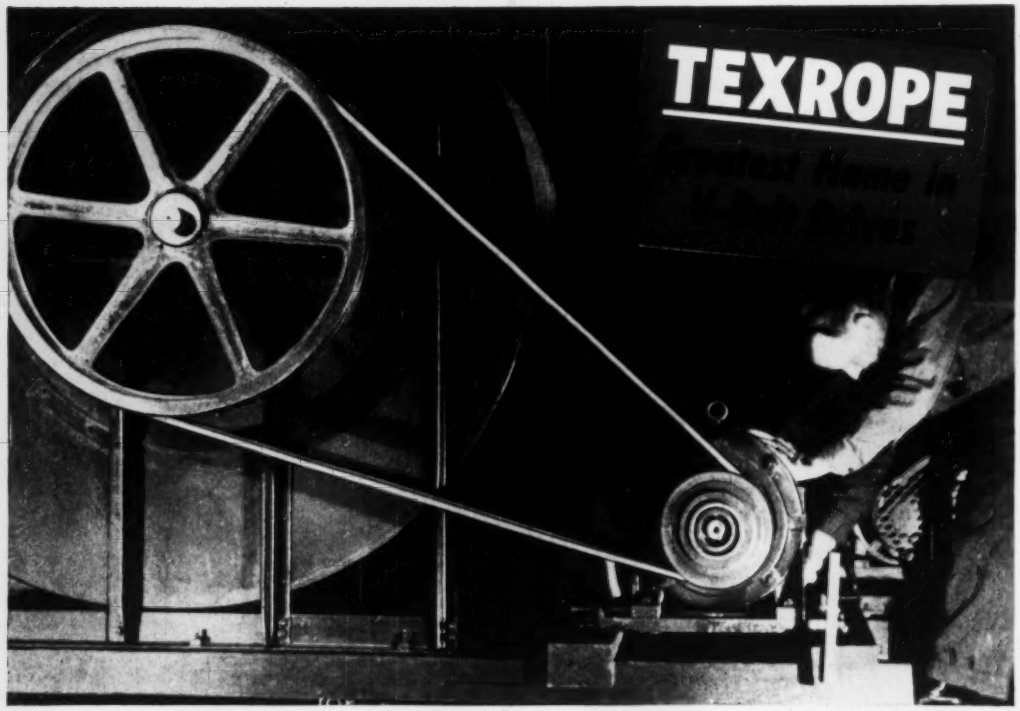
DETROIT
LUBRICATOR COMPANY

5900 TRUMBULL AVE., DETROIT 8, MICHIGAN
Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
Canadian Representatives: RAILWAY & ENGINEERING SPECIALTIES, LTD.—Montreal, Toronto, Winnipeg

"DETROIT"

DETROIT HEATING AND REFRIGERATION CONTROLS • ENGINE SAFETY CONTROLS • FLOAT VALVES AND OIL BURNER EQUIPMENT • DETROIT EXPANSION VALVES AND REFRIGERATION ACCESSORIES • STATIONARY AND LOCOMOTIVE LUBRICATORS

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



QUICK, EASY, LOW-COST

Fan Speed Adjustment

IT TAKES ONLY a few minutes to change the speed of a fan equipped with a *Vari-Pitch* Stationary Control sheave. You get an infinite number of speeds from one sheave and the speed will not change once it has been set. That is why system balancing and adjustments are easier and faster when your fan drives are equipped with *Vari-Pitch* Stationary Control Sheaves.

MOST COMPLETE LINE PLUS EXPERT ENGINEERING

You can get everything you need for your drive -- motor, base, starter, sheaves and belts — plus expert application engineering and practical help with one phone call. On your next fan job, get one-day, one-call service on the drive from your nearest Allis-Chalmers Authorized Dealer or Sales Office.

SEND FOR BULLETIN

More information on the complete line of *Vari-Pitch* drives is available in Bulletin 20B6082B. A-2900

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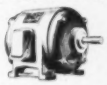
Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.

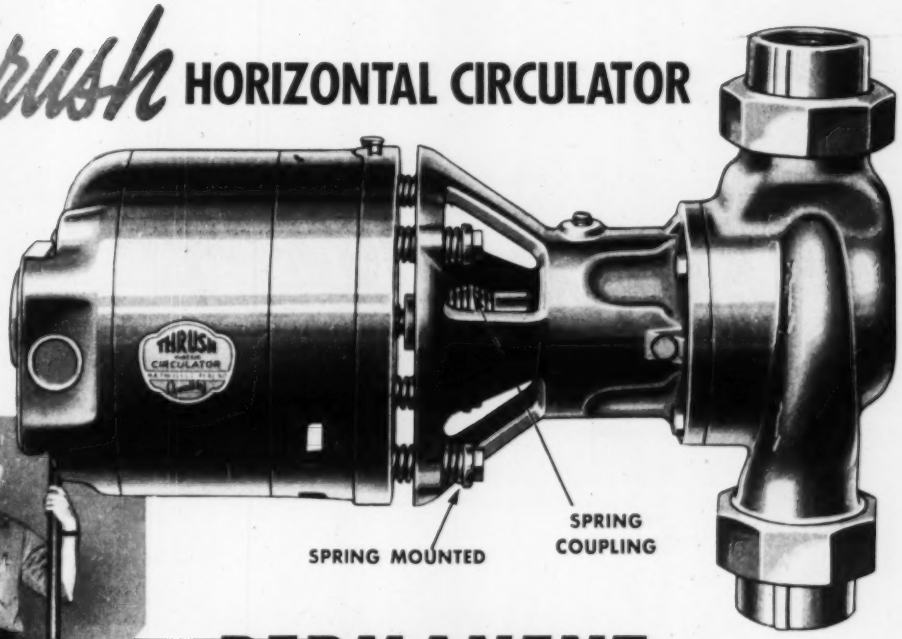
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Thrush HORIZONTAL CIRCULATOR



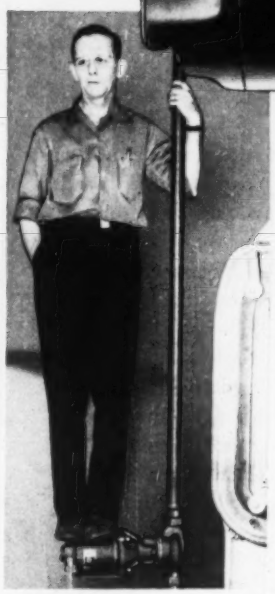


Illustration shows great strength of spring mounting which holds motor in perfect alignment always.

PERMANENT *Alignment!*

QUIET FOR A LIFETIME

THE THRUSH Horizontal Water Circulator is sturdily built, to operate efficiently and quietly throughout its life. Tempered steel spring mounting of motor to Circulator frame and patented spring coupling connection of motor and pump shafts, assure permanent alignment with smooth, vibration-free performance. The unique spring suspension never loses its resilience or sags, as no rubber is used. Sealed-in lubrication with positive oil flow over all moving surfaces, means freedom from wear and service troubles. Thrush pioneered Forced Circulating Hot Water Heat for homes, and this new Horizontal Type Circulator is the culmination of nearly a quarter century of experience in circulator building. Specify Thrush controls for real satisfaction.

ASK YOUR WHOLESALER ABOUT THRUSH EQUIPMENT OR WRITE DEPARTMENT E-2.

H. A. THRUSH & COMPANY • Peru, Indiana

Yes, it's Youngstown!

Dependable Steel Pipe . . . Adequate Tomorrow, as Today

INSTALL Youngstown today, in sizes adequate for the increased loads it will have to carry tomorrow, and both you and your customers can forget pipe indefinitely.

The dependability of Youngstown Steel Pipe rests on experience--on nearly 50 years of producing highest quality steel and fabricating it into highest quality pipe.

Youngstown Steel Pipe is available every where, sold by leading pipe distributors who are prepared to recommend and furnish it in proper sizes for any job, adequate for both tomorrow's needs and today's.

Youngstown STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices — Youngstown 1, Ohio

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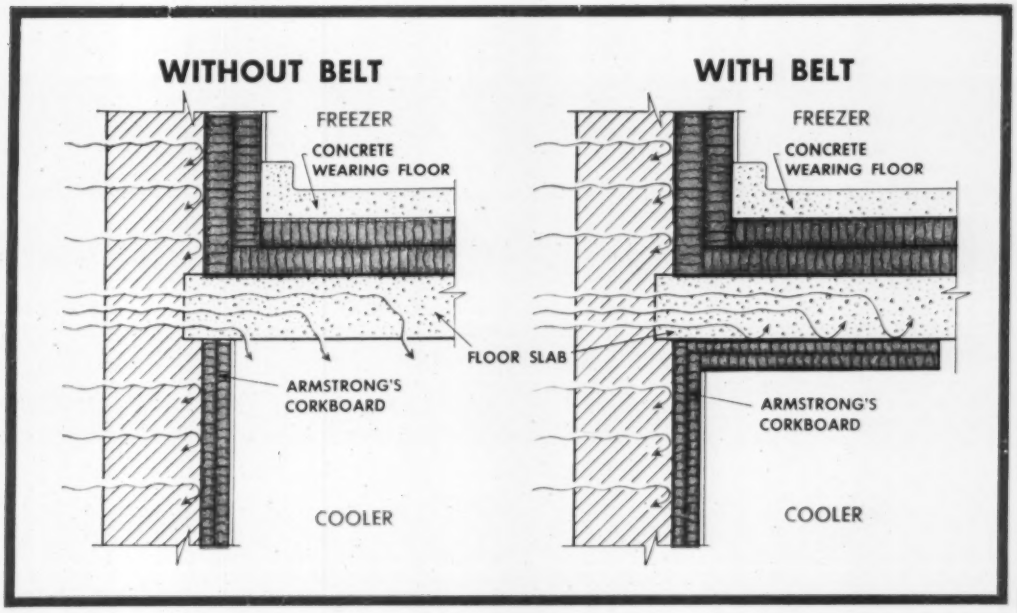
PIPE AND TUBULAR PRODUCTS · CONDUIT · BARS · RODS · COLD FINISHED CARBON AND ALLOY BARS · SHEETS · PLATES · WIRE · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · RAILROAD TRACK SPIKES.



How a belt of insulation prevents trouble

When the floor slab between refrigerated spaces is supported by the walls, heat travels along the slab into the room. This flow of heat not only increases refrigeration loads but also results in moisture condensation under the slab.

Extra insulation on the wall doesn't improve this situation. Even insulation on the floor between cold rooms won't eliminate it. But a belt of Armstrong's Corkboard on the underside of the slab, extending about three feet into the room, corrects it—and at low cost.

No such belt is required if the slab is supported by columns within the building and stands free of the outside walls. This permits an unbroken envelope of corkboard insulation to completely surround the entire refrigerated space.

The specification shown here, solving a common insulation problem in a practical and low-cost manner, is typical of the thinking of the men who plan Armstrong insulation jobs.

For more than 40 years these Armstrong engineers have been finding the right answers to all kinds of insulation problems. When you have any questions about low-temperature insulation, call on Armstrong's Contract Service. In addition to Armstrong's long experience and time-tested engineering practices, this complete service furnishes top-quality insulating materials and skilled mechanics to apply them. For complete information, write today to Armstrong Cork Company, Building Materials Division, 4402 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS INSTALLATION

FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.

26 & 20

FOR ECONOMY
FOR QUICK SELECTION
FOR PROMPT DELIVERY

26 SIZES

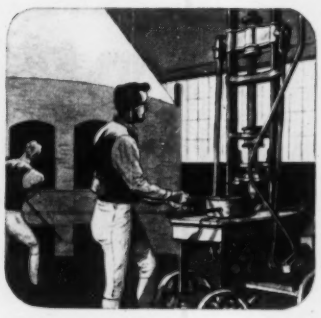
8 x 4
10 x 4
10 x 6
12 x 4
12 x 5
12 x 6
14 x 4
14 x 5
14 x 6
16 x 5
16 x 6
20 x 5
20 x 6
20 x 8
24 x 5
24 x 6
24 x 8
24 x 10
24 x 12
30 x 6
30 x 8
30 x 10
30 x 12
36 x 8
36 x 10
36 x 12

20 SIZES

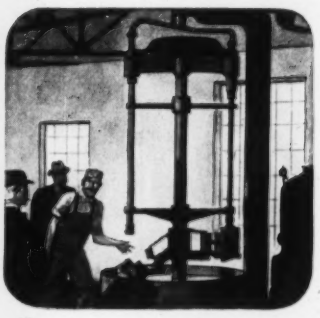
10 x 6
10 x 8
12 x 6
12 x 8
12 x 12
18 x 6
18 x 12
18 x 18
24 x 12
24 x 18
24 x 24
30 x 12
30 x 18
30 x 24
36 x 18
36 x 24
36 x 30
48 x 24
48 x 30
48 x 36

17B50

1 **1621**—Glass was money! America's first glass factory was actually a mint—not for the manufacture of coins but to make glass beads for *use* as money when buying land, food and furs from the Indians.



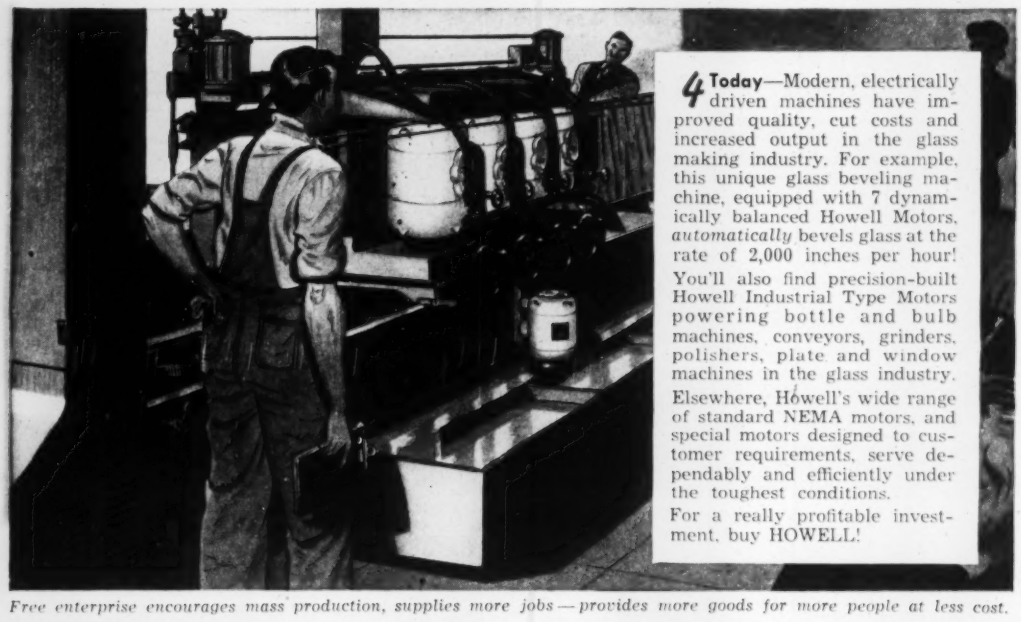
2 **1827**—Blown glass was the rule until Enoch Robinson, a carpenter, figured glass could be *pressed* into shape . . . the glass pressing machine was born. Electricity to power new machines was still to come.



3 **1899**—Owens invented a machine to make bottles as the machine age arrived in glass. By 1915, Howell "Red Band" Motors were making important contributions to this and other industries.

ANOTHER HOWELL SUCCESS STORY

GLASS...from artisans to automatic machines



4 **Today**—Modern, electrically driven machines have improved quality, cut costs and increased output in the glass making industry. For example, this unique glass beveling machine, equipped with 7 dynamically balanced Howell Motors, *automatically* bevels glass at the rate of 2,000 inches per hour!

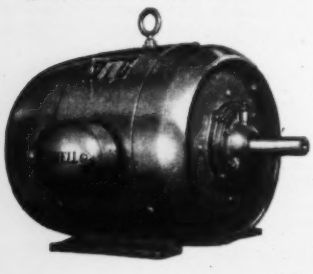
You'll also find precision-built Howell Industrial Type Motors powering bottle and bulb machines, conveyors, grinders, polishers, plate and window machines in the glass industry.

Elsewhere, Howell's wide range of standard NEMA motors, and special motors designed to customer requirements, serve dependably and efficiently under the toughest conditions.

For a really profitable investment, buy HOWELL!

Free enterprise encourages mass production, supplies more jobs—provides more goods for more people at less cost.

Howell totally enclosed, fan-cooled motor—windings completely sealed against dirt and weather.



HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

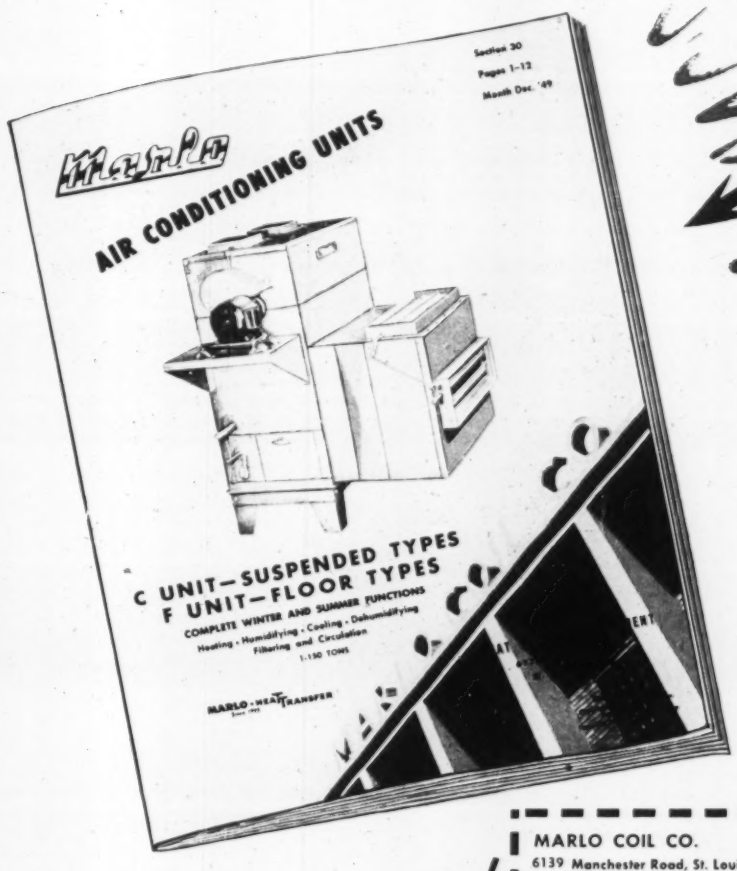
Precision-built Industrial Motors Since 1915

HOWELL Red Band MOTORS

IT'S READY!

Thanks for Waiting

A comprehensive new bulletin on the *complete* Marlo line of air conditioning units, with many new illustrations and simple explanations of many new designs.



Send for your free copy!

MARLO COIL CO.
6139 Manchester Road, St. Louis 10, Mo.

Gentlemen: Please send your new "Air Conditioning Units" bulletin to

Name.....
Company Name.....
Address.....
City.....Zone.....State.....

Marlo COIL COMPANY • SAINT LOUIS 10, MISSOURI

American Blower—a time-honored name in air handling

Venturafin Unit Heaters

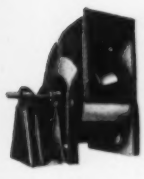
Type TM Gyrol Fluid Drives

Utility Sets

Ventura Ventilating Fans

Dust Collectors

Mechanical Draft Fans


Industrial Fans

Heating and Cooling Coils

Air Conditioning Equipment

In Philadelphia, as in other cities, American Blower Air Handling Products have been serving commerce, industry and public utilities for over half a century. For air handling data in the Philadelphia area, call American Blower—Rittenhouse 6-6393. In other areas, consult your phone book.

If you look before you buy, we're certain you'll buy American Blower Air Handling Equipment. There's a vast difference in quality, design, operating costs and efficiency between American Blower and ordinary equipment. In test after test by buyers, comparison proves the superiority of American Blower products.

Air is free . . . use it profitably!

MODERN air handling equipment costs less than 4% of the total cost of a building.

Yet its use saves millions each year in many industries . . . actually adds millions to profits in others.

Building the finest equipment for handling air and putting air to profitable use has been American Blower's business since 1881.

Today, time-honored American Blower Air Handling Equipment is available for installation in industrial, commercial and public buildings, schools, stores, and public utilities.

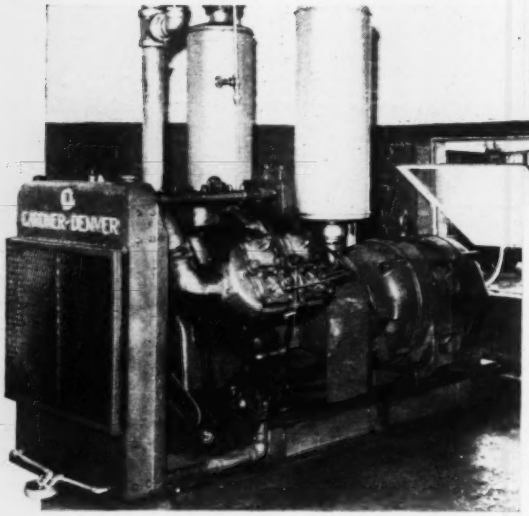
American Blower equipment is universally recognized as a better buy because it is quality built to last longer and to operate at lower cost.

If you would like to know how these products can profitably be applied to your business, or how you as a contractor can profitably apply them, phone the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY
AMERICAN BLOWER
AIR HANDLING EQUIPMENT

Serving home and industry
AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



"6,552 WORKING HOURS— AND WE HAVEN'T TOUCHED IT YET!"

"Our WB Compressor has now been in operation for a total of 6,552 working hours. A wrench has never touched the machine, and not one single cent has been spent for repairs. We plan to have the valves cleaned soon, but outside of that, the machine is in perfect running order."

—excerpt from owner's letter.

Low maintenance is just *one* of many major advantages in a Gardner-Denver WB Vertical, Two-Stage, Water-Cooled Compressor. You get big capacity, high efficiency air supply in limited space. A self-contained cooling system effectively lowers the discharge temperature—permits operation where good cooling water is scarce. And the WB is a packaged unit, easily installed and ready to go to work.

Gardner-Denver WB Compressors are built in capacities from 142 to 686 cubic feet displacement per minute. Write today for full details.

SINCE 1859

USE COMPRESSED AIR FOR SAFETY CONVENIENCE FLEXIBILITY

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada:
Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

Kno-Draft

. . . the completely adjustable Air Diffusers, specified by Western Union for big, high speed communications center at Philadelphia

In spaces filled with mechanical equipment, cable racks, transmitting machinery and storage partitions, Kno-Draft's facility for delicate regulation of air volume and direction enabled the air conditioning engineers to produce precisely the air pattern best suited for the purpose of each area in the communications center.

The system was balanced to within 5% and the temperatures equalized so evenly that measurements showed a maximum difference of only one-half degree throughout.

FREE HANDBOOK – Send for FREE copy of new handbook on air diffusion. Complete information on Kno-Draft Adjustable Diffusers and all necessary engineering data to help you create "custom-made" air patterns. Just fill in and mail the coupon.

These Kno-Draft features insure satisfaction.

Fig. 1.

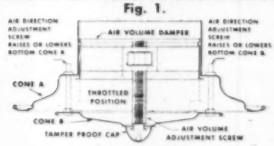
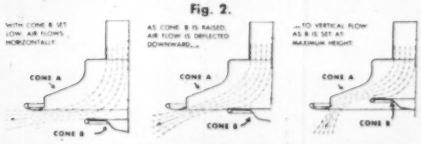

AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B
AIR VOLUME DAMPER
AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B
CONE A
THROTTLED POSITION
CONE B
TAMPER PROOF CAP
AIR VOLUME ADJUSTMENT SCREW

Fig. 1. Type D Air Volume Control consists of a cylindrical, sliding, sleeve-type damper, connected by a specially designed spider to a centrally operated screw. It varies only the quantity, not the characteristics, of the air distribution. Fig. 2. Any angle of air discharge can be obtained by raising or lowering bottom Cone B.

Fig. 2.


WITH CONE B SET LOW, AIR FLOWS HORIZONTALLY
CONE A
CONE B
AS CONE B IS RAISED, AIR FLOW IS DEFLECTED DOWNWARD...
CONE A
CONE B
...TO VERTICAL FLOW AS B IS SET AT MAXIMUM HEIGHT
CONE A
CONE B

W. B. CONNOR ENGINEERING CORP.

Air Diffusion • Air Purification • Air Recovery

112 East 32nd Street CONNOR **New York 16, N.Y.**

IN CANADA: Douglas Engineering Co., Ltd., 190 Murray Street, Montreal 3, P. Q.

W. B. CONNOR ENGINEERING CORP.

Dept. D-22, 112 East 32nd Street, New York 16, New York

Please send my FREE copy of the new Kno-Draft Handbook on Adjustable Diffusers.

Name .....

Position .....

Company .....

Street .....

City ..... Zone ..... State .....

first choice for Air Conditioning

RELIABLE, COMPACT, EASY TO INSTALL

MOTOR AND PUMP combined in a single unit means installation is easy. No extra parts to buy, no alignment problems. Less space is required than for base mounted units. Maintenance is reduced because alignment cannot change.

The *Electrifugal* Pump has a one piece cast iron yoke and bracket for mounting pump, eliminating a separate adapter. It uses a single shaft for both motor and pump. Further, the motor is specially designed and built by the same maker. Only Allis-Chalmers offers you the complete unit—pump, motor, control and drive—*all* of coordinated design and manufacture!

APPLICATION ENGINEERING SERVICE

Allis-Chalmers pump engineers, backed by the most modern pump research and testing equipment in the industry will help you select an *Electrifugal* pump or any other for your particular needs. Call your Allis-Chalmers Authorized Dealer or Sales Office today or see your Sweet's catalog for information on the full line of A-C pumps. A-2936

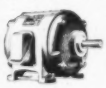
Electrifugal is an Allis-Chalmers trademark.

ALLIS-CHALMERS, 1171A SO. 70 ST. MILWAUKEE, WIS.

ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

For "Built-In" Permanence

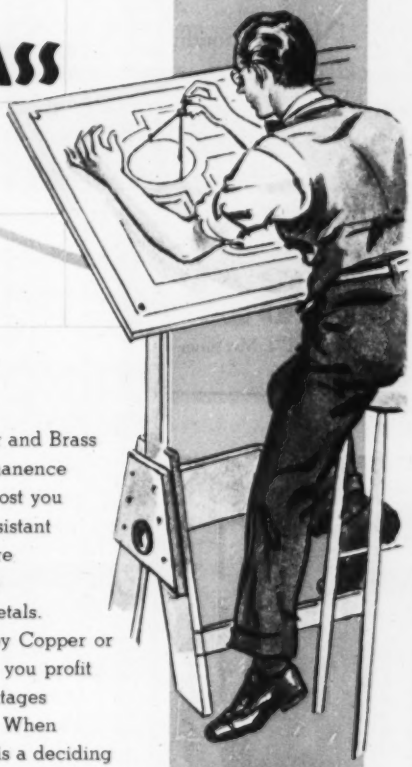
DESIGN WITH

HUSSEY

COPPER AND BRASS

Give Your Products

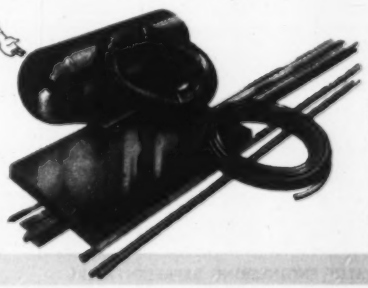
Dependability at **Low Cost**



Check these Advantages

- ★ Corrosion Resistance
- ★ Electrical Conductivity
- ★ Easy Fabrication
- ★ Thermal Conductivity
- ★ Lifetime Durability
- ★ Lasting Beauty

Versatile Hussey Copper and Brass give your products permanence and dependability at a cost you can afford. Corrosion resistant and durable under severe service conditions, these truly are the *ageless* metals. When you design Hussey Copper or Brass into your product, you profit by the cost-saving advantages of simplified fabrication. When permanence at low cost is a deciding factor in your products . . . design with Hussey Copper and Brass.



Sheet . . . Strip . . . Coils . . .
Fabricated Products (Rods . . .
Wire . . . Tubing . . . Nails)

COPPER HUSSEY BRASS

Our 102nd year
1848-1950

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES
PITTSBURGH 19, PA.

7 Convenient Warehouses to serve you promptly!

PITTSBURGH, 2850 Second Avenue • CLEVELAND, 5318 St. Clair Avenue • NEW YORK, 140 Sixth Avenue • CHICAGO, 3900 N. Elston Avenue • ST. LOUIS, 1620 Delmar Boulevard • PHILADELPHIA, 1632 Fairmount Avenue • CINCINNATI, 424 Commercial Square

WHETHER YOU MAKE AXLES

OR XYLOPHONES

AIR BY "Buffalo" HELPS YOU DO IT BETTER

NEED humidity control to halt rust? Looking for a cheaper way to convey materials? Want to remove corrosive gases from a continuous process? Striving for a better product and more of it? Better industrial relations? Lower accident rate? All these and many other air jobs are being done throughout industry by "Buffalo" Fans and Air Conditioning Units. "Buffalo" units will work quietly, day and night, in your plant — removing impurities, tempering, ventilating, cooling or heating — providing the atmosphere in which your product and your personnel can be at their best.

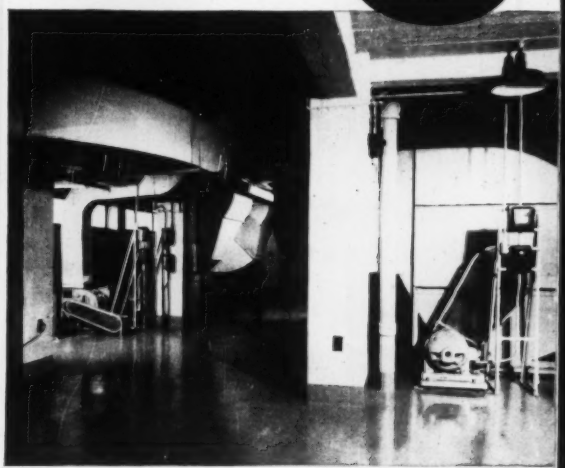
BUFFALO FORGE COMPANY

171 Mortimer St. BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" FANS AND AIR CONDITIONING

Branch Offices in All Principal Cities



AIR CONDITIONING — OR SIMPLE VENTILATION?

"Buffalo" Air Conditioning Units can create and maintain literally any "climate" your plant requires—efficiently and at a very reasonable operating cost. Above, an air washer removes dust and humidifies a large plant. Many "Buffalo" Air Washers have been continuously on the job for over forty years.

A good, reliable fan like this "Buffalo" Limit-Load model might well provide all the cooling and general air comfort for your plant needs—when other air processing is not called for. Many "Buffalo" Fans have been on the job for forty, fifty and more years. The "Buffalo" line is COMPLETE—to suit any budget, any requirements.

YOUR NEARBY "BUFFALO" ENGINEERING REPRESENTATIVE

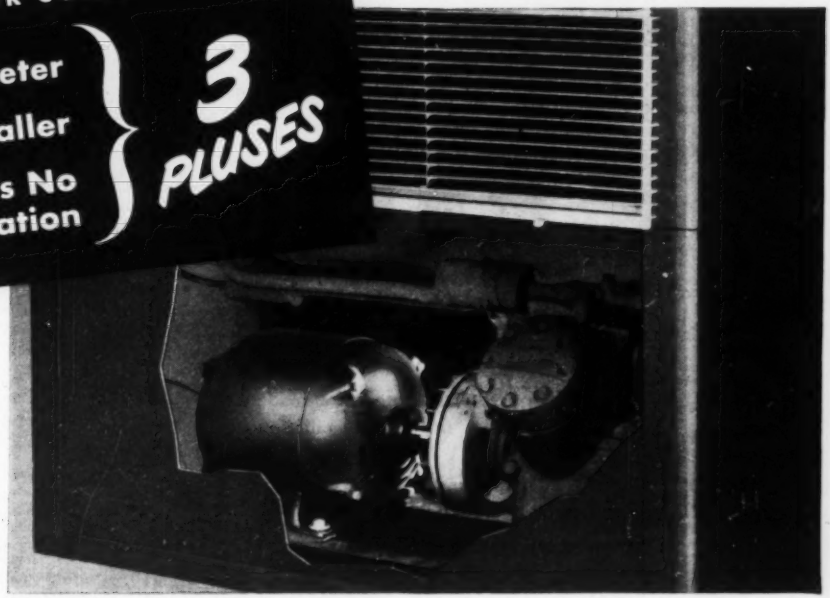
will give you recommendations — based on your problem and your budget — on turning your plant air to profitable use. He's a Graduate Engineer with 1-5 years of factory training. He's yours to call on, with no obligation.

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

FOR AIR CONDITIONING

Quieter
Smaller
Needs No Lubrication

3 PLUSES



Only Life-Line offers ALL THREE

Air conditioning equipment should be "felt", not "heard". That's where Life-Line offers builders and users of air conditioning and refrigeration equipment an important advantage.

Ventilating design—the maintenance of exact air gap . . . proper cooling and winding distribution—limit "windage" noise. Dynetric balancing assures absolute smoothness. New manufacturing techniques provide micrometer alignment. Result? A minimum of noise-producing vibration. In fact, you can edge-balance a coin on a Life-Line through a start, run, stop cycle. It's *that* smooth running.

Quietness is but one feature; compactness, another. Life-Line's 1/3 smaller size (over conventional-type motors) is a valuable asset when design allows only limited space. Too, Life-Line needs no lubrication. Install it in "hard-to-get-at" locations . . . crowd it into cramped quarters—and forget it!

Only Life-Line offers all three—quietness, compactness, and lubrication freedom. Why not put them to work? A phone call to your nearby Westinghouse representative will bring you complete details. Contact him now, or write Westinghouse Electric Corporation, P. O. Box, 868, Pittsburgh 30, Penna. J-21578

Westinghouse
Life-Line
Motors

WESTINGHOUSE

. . . If you figure **LIFE-COSTS** *. . . you'll figure* **LIFE-LINE** *. . .*

fedders
A Great Name Since 1896

OFFERS
AMERICA'S MOST COMPLETE LINE OF

CONVECTOR-RADIATORS

Type F

Type FE

Type FB

Type SF

Type SFB

Type W

Type S

Type R

Type RB

Type RC

Type RCB

Type P

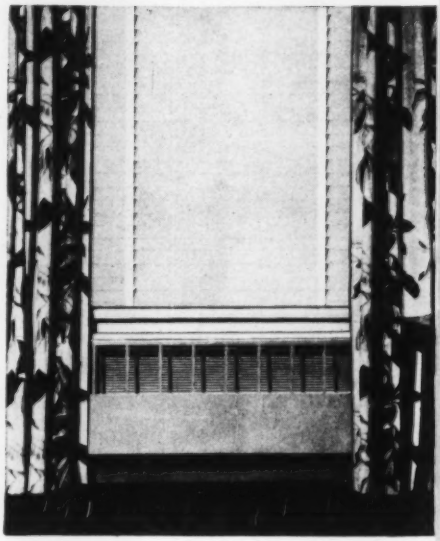
Type PB

Fedders Convector-Radiators are made in sizes and types to fit every installation requirement.

They are made in standard Type F free-standing and semi-recessed models available from stock and also a wide range of models for special applications.

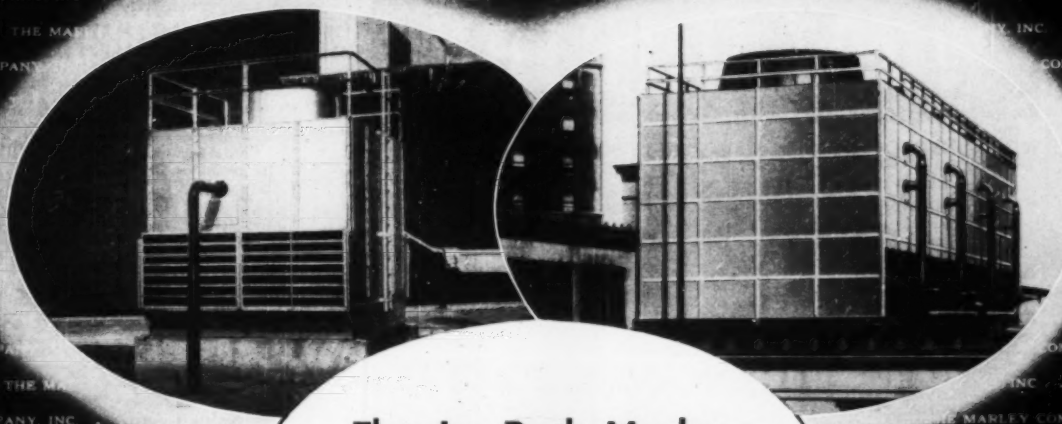
Men who design, sell and install heating equipment can take advantage of Fedders wide range of models including flat and sloping top, wall hung and free-standing models with and without base grilles. Other models include semi and completely recessed Convector-Radiators with overlapping and plaster fronts to conform to any decorative scheme.

Fedders heating elements also available for use with individually designed concealed systems. Heating elements provide quick response to manual and thermostatic control. Write for data sheets. Consult yellow section of phone book for your local Fedders representative.



Also manufacturers of Fedders Unit Heaters, Wall Radiation, Unit Coolers, Air Cooled Refrigeration Condensers, Room Air Conditioners, Automotive Radiators and Car Heater Cores.

FEDDERS-QUIGAN CORPORATION
BUFFALO 7, N. Y.



They're Both Marley Towers

Which Do You Need?

YOU want a cooling tower that will handle your water cooling job effectively at the least possible cost!

But, do you know which cooling tower will do it?

That's where Marley "know-how" fits into your picture. You have a water cooling job to do. There's a Marley designed and Marley built cooling tower to meet every water cooling need. Marley trained Application Engineers, working with you from the blue-print stage on, will help you get more for your money and assure complete, lasting satisfaction.

Shown above are two of the many Marley cooling towers from which Marley engineers can make a selection to fit your need:

The VAIRFLO (left) a medium capacity cooling tower with extra quality features at no extra cost. Vairflo extras include a balanced spray system with patented Marley low pressure nozzles . . . totally enclosed motor . . . grease packed ball bearings in enclosed bearing housing . . . lifetime nail-less filling . . . filling that is easily removed and installed . . . complete basin fixtures . . . Marley-designed cooling tower fan . . . multiple cells if desired . . . extra heavy framing and casing to give unusually long service. The Vairflo sets a new standard for air conditioning and refrigeration service. Available in wood or steel. Bulletin V-50.

The CONVENTIONAL (right) with a model to meet all heavy duty water cooling requirements. Only Marley Conventional towers offer all these features . . . rigid fan cylinders . . . cast aluminum or stainless steel fans . . . motors propery located outside the fan cylinder . . . positive drive action . . . drift eliminators independent of the distribution system . . . spray nozzle distribution . . . nail-less filling . . . independent louver posts . . . exclusive Marley mechanical equipment. Available in wood or steel. Asbestos board casing if desired. Bulletin C-50.

For guaranteed performance at lowest possible cost, ask a Marley Application Engineer to study your cooling requirements with you, from the blue-print stage on, and to give you a fair and impartial recommendation for the type of equipment that best meets your need. There's no cost nor obligation.

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas

☐ Please send me, FREE, your latest illustrated folders entitled, "What's Your Cooling Tower I.Q.?" I'm particularly interested in Cooling Tower Maintenance, Operation, Specifications, Testing, Water Treatment, Water Distribution.

☐ Have a Marley Application Engineer call to discuss our water cooling problem.

HP-2

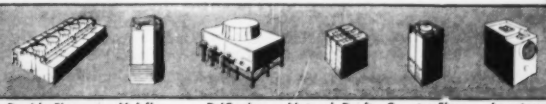
Name _____ Title _____

Company Name _____

Address _____

City _____ Zone _____ State _____

MARLEY



Double-Flow Vairflo DriCooler Natural Draft Counter-Flow Aquatower

Spray Nozzles

WORTHINGTON AIR CONDITIONING REPORT

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

Specialists in air conditioning and refrigeration for more than 50 years

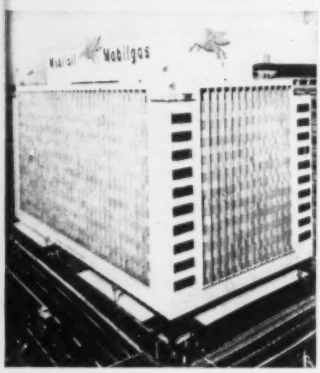
New Weather-Making Plant Has Finger-Tip Control

Thermostats Each 14 Feet, Four Fan Rooms On Each Floor, Assure Flexibility

A weather factory huge enough to turn out a ton of ice every day for every office in the new General Petroleum building, but sensitive enough to supply a different temperature every fourteen feet throughout the entire half-million square foot structure . . . that's the heating and air conditioning plant in General Petroleum Corp.'s new building in Los Angeles.

Basic approach in design of the equipment, which was done by the office of Ralph E. Phillips, consulting mechanical and electrical engineers, was determined by Southern California weather which may require the building to be heated and cooled simultaneously. One duct brings cooled air and the other heated air to all portions of the building.

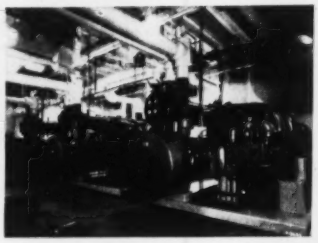
The outlets are spaced to fit the modular design of the building which is on a 14 and 7 foot plan. Outlets are located each 14 feet on most floors; a few floors, where smaller offices



may be used, have outlets every 7 feet.

Each outlet has its own thermostatic control—more than a thousand controls altogether. Since most offices are 14 feet in width, that means each office can choose its own weather.

The controls operate dampers



which automatically mix the hot and cold air to provide the desired temperature. A minimum of six and an average of eight complete air changes hourly are provided.

Feeding the air to the twin-duct system are 48 fan rooms. Four are located on each floor from the second to the top floor of the 13-story building. Each fan room contains heating and cooling coils and a 3 horsepower electrically driven fan flowing 7500 cfm.

The refrigeration plant consists of three Worthington 300-hp centrifugal compressors, using "Freon 11", with a capacity of 333 tons each. Chilled water from the refrigeration plant is circulated to the cooling coils in the fan rooms, from where the cooled and conditioned air is distributed throughout the building. Cooling towers are located on the roof.

W. S. Kilpatrick & Company, Los Angeles, contractors. Wurdeman & Becket, Los Angeles, Architects.

Hot News Gets Cooled Off

The Nashville Tennessean and the Nashville Banner are published in Newspaper Printing Corp.'s air conditioned building.

The entire building, with the exception of the press room with its large printing roll presses, is air conditioned with Worthington equipment. Executive offices have individual temperature control. Multiple zone control for the building is provided by using face and by-pass dampers plus hot water reheat.

Air conditioning is provided by a Worthington centrifugal refrigeration system with a 150 ton refrigeration capacity. Chilled water is distributed to nine AVY and AHY type central plant air conditioning units which have chilled water cooling coils. A Worthington chilled water pump and two tower pumps complete the equipment for the system

Architects and Engineers: Marr & Holman, Nashville. Contractors: J. M. Gallagher Co., Nashville.

Looks . . . and Feels Different

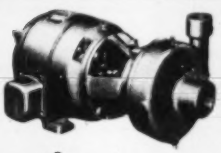
The Kaufman Department Store in Colorado Springs, Colorado, starts its 54th year in business with a new look and a different climate. All three floors of the store are air conditioned with Worthington equipment, which includes a 6HF4 Freon-12 condensing unit and a 4HF4 Freon-12 condensing unit. The latter controls temperature of basement and first floor, the 6HF4 unit controls second floor. Zone control is used by both. Consulting engineer: Douglas Jardine, Colorado Springs, Colorado.

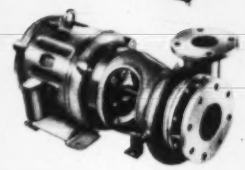
A9-21

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

A complete line . . . in which *all* the vital components are *made*, not just assembled by Worthington. For *more worth with Worthington*, see your nearby Worthington distributor (consult Classified Telephone Directory).



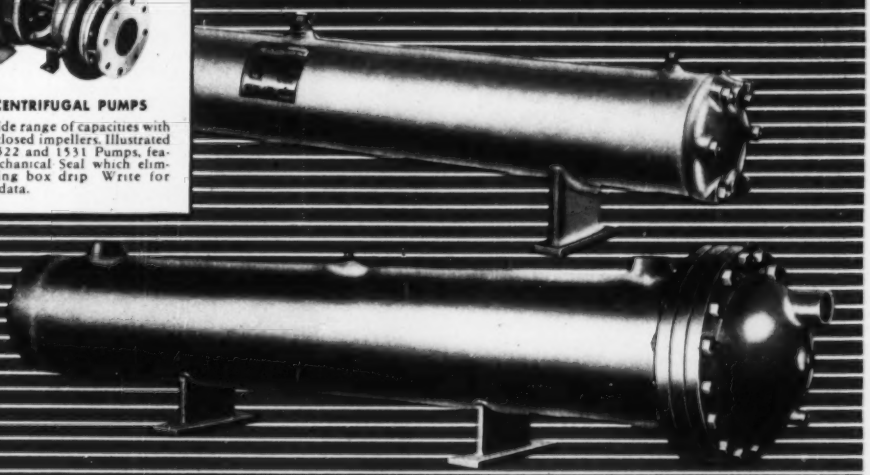


B & G CENTRIFUGAL PUMPS

Made in a wide range of capacities with open and enclosed impellers. Illustrated are Series 1522 and 1531 Pumps, featuring a Mechanical Seal which eliminates stuffing box drip. Write for engineering data.

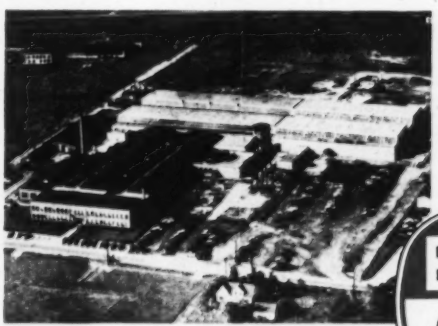
Precision Built

FOR BETTER HEAT TRANSFER ...LONG DEPENDABLE SERVICE



The Bell & Gossett Company believes that its products should *give* service—not require it! This insistence on quality is evident in your first glance at any unit of B & G Refrigeration Equipment. You'll find new and better design—rugged construction—painstaking workmanship—all combined to produce top efficiency in performance and longer service life.

The many refinements added to the basic soundness of B & G design reflect the skill developed in over a quarter century of making fine heat transfer equipment. B & G Evaporators, Condensers, Heat Exchangers and Centrifugal Pumps assure you of that priceless asset—*customer satisfaction!*



You are cordially invited to visit the B & G Plant

You'll be interested in seeing the modern manufacturing methods and precision workmanship which make B & G *Hydro-Flo* Products known everywhere for superior quality and performance.

Send for these catalogs

B & G Refrigeration Equipment is described and illustrated in these two catalogs. Complete engineering data is given, together with simplified selection procedures. Your copies will be sent upon request.

B & G

*Hydro-Flo**

REFRIGERATION EQUIPMENT

BELL & GOSSETT COMPANY

Dept. RBJ-5, Morton Grove, Illinois

*Reg. U. S. Pat. Off.

BARBER COLMAN

MOTOR-OPERATED VALVES

FOR

ZONE CONTROL

TYPE FYBA
MOTOR OPERATOR
ON
GLOBE FLANGED
VALVE BODY

Zone control systems on hot water and steam heating installations require good, remotely-controllable valves for efficient operation. Barber-Colman Motor-Operated Valves have proved ideal for this service in thousands of buildings of all types and sizes. Barber-Colman Valves are ruggedly built for *maximum performance with minimum maintenance.* They are made in all standard sizes up to 6″, with globe screwed pattern from ¾″ to 4″ and globe flanged pattern from 2½″ to 6″. Three types of motor-operators are available; choice depending on service requirements. Barber-Colman Motor-Operated Valves are delivered *completely assembled* ready for installation. Motors operate on low voltage and valves may be remotely (and automatically) controlled by any three-wire circuit single-pole double-throw switch or its equivalent, such as a thermostat, pressure switch, or relay. Be sure your files include latest engineering data on these useful, dependable, economical Valves. *Consult your Barber-Colman representative for any advice on these applications.*

BARBER-COLMAN COMPANY
1228 ROCK STREET • ROCKFORD, ILLINOIS

Write for Literature

NATION-WIDE SALES AND ENGINEERING SERVICE

Copper Tube Pipelines

offer these three basic advantages

1. **FLEXIBILITY,** in installation and in operation. Bends and offsets to clear beams and girders are readily made in copper tubes; soldered connections can be made in spaces too restricted to manipulate a wrench. Once installed, copper tubes connected with solder fittings can be taken down, moved, or have new connections cut in faster and with less expense than with threaded pipe.

2. **MODERATE COST,** for material and for labor. Solder-type fittings eliminate threading, reduce tube weight, require minimum time for layout and installation.

3. **SUPERIOR PERFORMANCE.** Solder fittings give uniformity of bore to copper tube piping; flow is unimpeded at joints, and the rust-free surface of copper means a low coefficient of friction, with reduced pumping costs. The corrosion resistance of copper provides assurance against premature pipe replacement and excessive maintenance cost.

ANACONDA

Anaconda

COPPER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 20, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

ANACONDA Copper Tubes in standard sizes are manufactured to A.S.T.M. and Federal Specifications. Types K and L are furnished soft in long coils; also hard and soft in 20-ft. lengths from $\frac{3}{8}$″ to 12″ in diameter. Type M tube is furnished hard only in 20-ft. lengths from $1\frac{1}{4}$″ to 12″ in diameter for waste, drainage and vent lines. Larger sizes, up to 26″ I.D., can be made to order.

Write for Publication C-24 on ANACONDA Copper Tubes and Fittings.

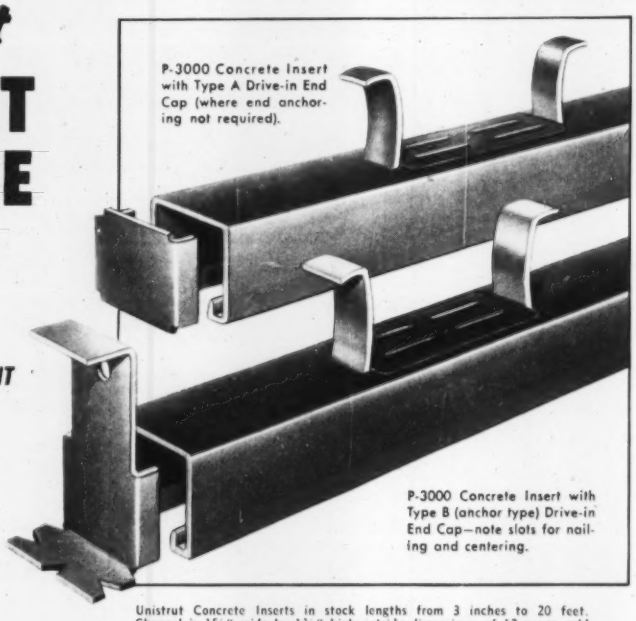
4180 Rev.

Announcing an Entirely New, Improved, Lower Cost

UNISTRUT CONCRETE INSERT

WITH A CONTINUOUS SLOT THAT PERMITS ATTACHMENT ANYWHERE ALONG ENTIRE CHANNEL

WITH POSITIVE CLAMPING ACTION PROVIDED BY THE SLIDING EASILY-INSERTED UNISTRUT SPRING NUT



P-3000 Concrete Insert with Type A Drive-in End Cap (where end anchoring not required).

P-3000 Concrete Insert with Type B (anchor type) Drive-in End Cap—note slots for nailing and centering.

Unistrut Concrete Inserts in stock lengths from 3 inches to 20 feet. Channel is $1\frac{5}{8}$" wide by $1\frac{3}{8}$" high outside dimensions, of 12-gauge cold rolled steel. Load capacity 2000 lbs. per foot with a safety factor of 3.

A CHALLENGE—We believe this to be the greatest development in concrete insert design and manufacture since concrete inserts were first introduced . . . with advantages that are obtainable only and exclusively with Unistrut. Attachments are easily and quickly made by inserting Unistrut spring nut when and where you wish without disturbing other attachments. Bolting of fitting secures the nut tight to "double track" formed by inturned edges of channel, provides positive clamping action, prevents slippage. Standard lengths up to 20 feet make these the longest concrete inserts ever offered!

CONCRETE INSERTS PART OF UNISTRUT FRAMING SYSTEM

The concrete inserts shown in this folder are part of Unistrut—a completely adjustable metal framing system that provides a new and more flexible type of mechanical support for every kind of piping, conduit, cable, and for every conceivable kind of equipment used in industry today. Unistrut is metal channel with a continuous slot. You simply insert the Unistrut spring nut into the channel at approximate point where attachment of another framing member is desired, slide to exact location and bolt to Unistrut fitting. Unistrut includes concrete inserts, roller pipe supports, brackets, clamps, hangers and many other standard parts which in combination provide the world's most flexible system of support or suspension. Unistrut does the complete job—you need no other parts or materials. No drilling, no welding—100% adjustable and reusable.

Write for your Free Sample of Unistrut and new Concrete Insert Bulletin today!

UNISTRUT PRODUCTS COMPANY
1013 W. Washington Blvd., Chicago 7, Ill., Dept. H2

Please send free sample of Unistrut and Bulletin CI-2.
Bulletin CI-2 ☐ Unistrut Sample ☐

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

U. S. Patent Numbers
2327587 2380379
2363382 2345650
2329815 2405631
Other patents pending

UNISTRUT
The World's Most Flexible All-Purpose Metal Framing

THE 3 QUICK UNISTRUT STEPS

1. Insert Nut into Channel
2. Locate Fitting and Nut
3. Tighten Bolt —it's done

Prompt Delivery from Warehouse Stocks in Principal Cities, Consult your Telephone Directories

UNISTRUT PRODUCTS COMPANY
1013 W. Washington Blvd. • Chicago 7, Illinois

DEPENDABILITY

THE TRUE MONEY-SAVER IN EVERY "BUFFALO" PUMP

OLD FAITHFUL GEYSER, spouting 12,000 gallons of scalding water 150 feet into the air every 66½ minutes, has been a byword for DEPENDABILITY to millions of tourists since its discovery in 1870.

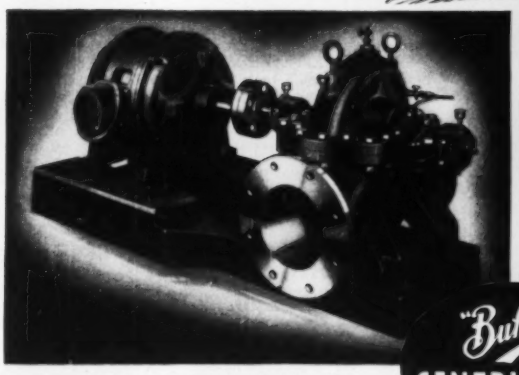
"BUFFALO" PUMPS have an equally strong reputation for dependability with thousands of users. AND THIS MEANS ECONOMY IN EVERY PUMPING JOB! It means freedom from costly repairs—and, more important, freedom from long shutdowns, which are the big cost of pump failure.

Why take a chance? Back up your liquid-moving jobs with "Buffalo" Pumps and enjoy the true economy in this dependability. Call on your nearby "Buffalo" Engineering Representative for complete information.

BUFFALO PUMPS, INC.

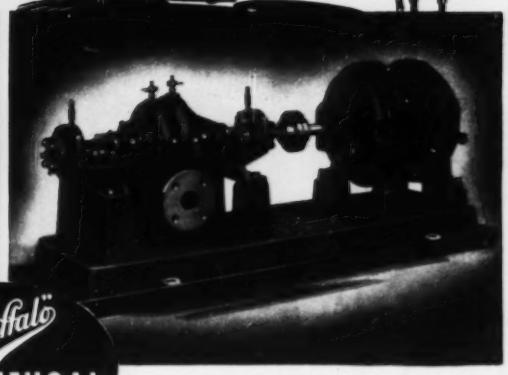
171 Mortimer St., Buffalo, N. Y.
Canada Pumps, Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities



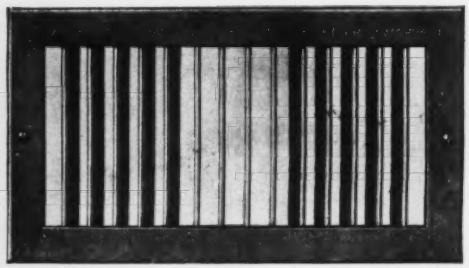
"Buffalo" Class "SL" Pumps are widely used on air conditioning systems and for other clear water service. Write for Bulletin 955-N and see their heavy-duty precision construction.

"Buffalo" CENTRIFUGAL PUMPS

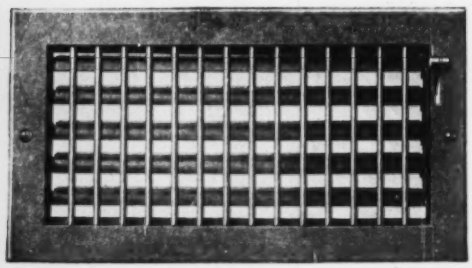


"Buffalo" Class "RR" Pumps for boiler feed and general service are popular with users for their efficiency and durability on the job—in models to deliver from 20 to 900 gpm at heads up to 1500 ft. Write for Bulletin 980-B.

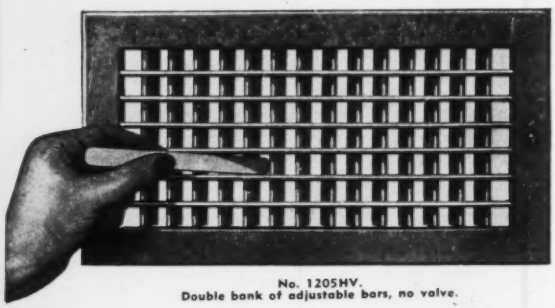
When You Compare Registers and Grilles for High Velocity Systems – You'll Choose AUER "Streamliners"



No. 1005V.
Single bank of adjustable bars, no valve.



No. 1005V-HML.
Single bank of adjustable bars, with multi-louvre valve.



No. 1205HV.
Double bank of adjustable bars, no valve.

Grilles with single or double banks of adjustable bars, also single or double face registers with multi-louvre volume control, are now made by several manufacturers. We believe most of these products for high velocity systems of air conditioning, ventilating, or cooling, to have merit. However, we believe Auer "Streamliners" are in a class by themselves, for these reasons:

1. The hollow moulded bars, smooth in contour, are pivoted in the frame on unique split sleeves, or expansion inserts, effective for the life of the register. These furnish just enough tension to hold bars firmly where set, yet allow sufficient play to adjust accurately with one simple tool.

2. Each bar is pivoted in its exact center, and shaped somewhat similar to an airplane wing, so that for either return or supply, each bar can be completely turned around. For outlets, some users turn the thin edge to the front, and the broader edge toward the flow of air, thus using a basic theory of aerodynamics, and reducing resistance and turbulence to a minimum.

3. Blades of multi-louvre volume control are pivoted on tension rivets to guard against vibration or noise, another important feature.

4. There is nothing, so far as we know, to wear out, pull loose, or give way in service, in a Streamliner.

Air conditioning and cooling experts know that these intakes and outlets call for specialized design and manufacturing ability. Auer is a pioneer in high grade air conditioning and cooling work. Compare the engineering merits of *all* registers for high velocity outlets. Then you will appreciate the superiority of Streamliners.

8 MODELS. The Series includes models with single bank of adjustable bars (vertical or horizontal), also with double bank of adjustable bars (vertical in front and horizontal in back, or the reverse), also all above four types with the addition of horizontal multi-louvre valves in the rear, controlled by lever on face of register.

Ask for Bulletin S-49. For forced air or gravity registers, we will send you complete Auer Register Book—for perforated grilles, Catalog "G".

THE AUER REGISTER CO., 3608 PAYNE AVENUE, CLEVELAND 14, OHIO
CANADIAN DISTRIBUTOR, MARCHAND FURNACE, LTD., TILBURY, ONT.

Auer REGISTERS & GRILLES for AIR CONDITIONING & GRAVITY

2 Ways TO GREATER ECONOMIES

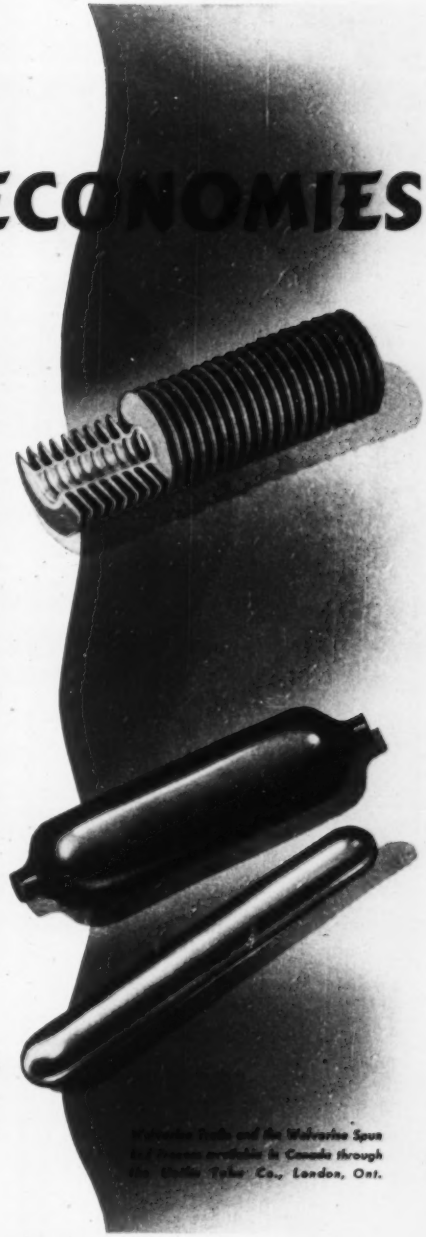
use Wolverine *Trufin for heat transfer

Worthwhile savings are effected in most installations. Unit costs are decreased because less tubing is required for each installation; consequently, the use of much other material is eliminated. Labor, too, is reduced. Note in the illustration how the fins are formed from the tube itself to give you a finned tube that will withstand vibration and extreme temperature changes.

use Wolverine Spun End Process for tubular parts

Plain tubing is often employed in the fabrication of tubular parts because it has been found so much more economical than other methods of forming. This is particularly true in cases where the ends are formed in special shapes—with or without openings. For this fabrication investigate the Wolverine Spun End Process.

*REG. U. S. PAT. OFFICE



Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Trufin Tube Co., London, Ont.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company

1419 CENTRAL AVE. DETROIT 9, MICHIGAN

MANUFACTURERS OF SEAMLESS, NON-FERROUS TUBING

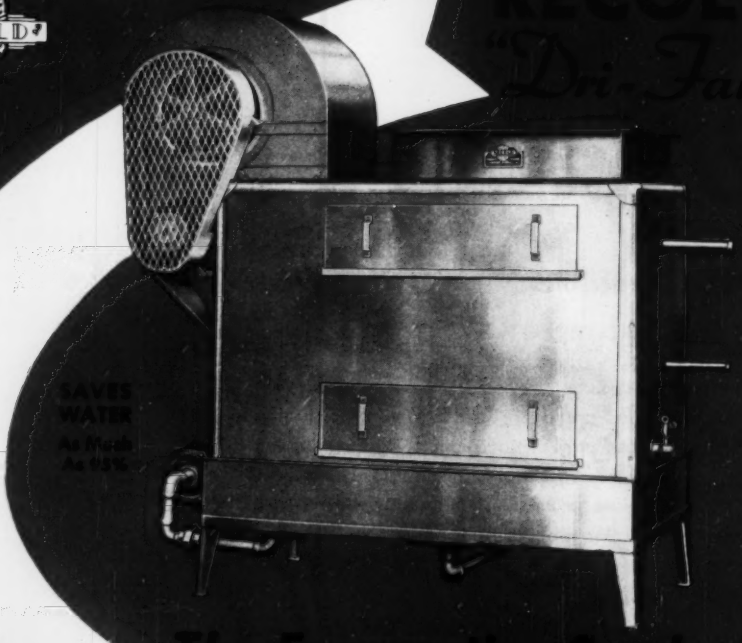
Plants at Detroit and Decatur, Ala.

Stocks Available at All Wolverine Mill Depots:
DETROIT, MICH. • DECATUR, ALA. • HOUSTON, TEXAS
LOS ANGELES, CALIF. • LONG ISLAND CITY, N. Y.

Sales Offices in Principal Cities

RECOLD

RECOLD "Dri-Fan"



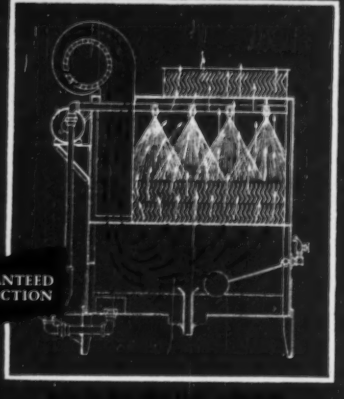
SAVES WATER
As Much As 95%

The Evaporative Condenser That Revolutionized An Industry

"Dri-Fan" — an engineering achievement that adds many years of life to evaporative condenser operation. A revolutionary design keeps the fan section free from moisture and lint — a big advancement to the commercial refrigeration and air conditioning industry.

Troublesome rust and corrosion which cause condensers to drench down and fail has been eliminated.

Here is your assurance of dependable, low-cost, trouble-free condenser operation. "Dri-Fan" Condensers are available in sizes from 5 to 150 tons. Split circuit operation if desired. Insist on Recold "Dri-Fan" whenever you buy or specify an evaporative condenser.



GUARANTEED PROTECTION

Write or wire us for full information.

Refrigeration ENGINEERING, INC.

MANUFACTURERS OF AIR CONDITIONING AND COMMERCIAL REFRIGERATION EQUIPMENT

4560 East Firestone Avenue ..... Los Angeles 22, California

What kind of dog is this?

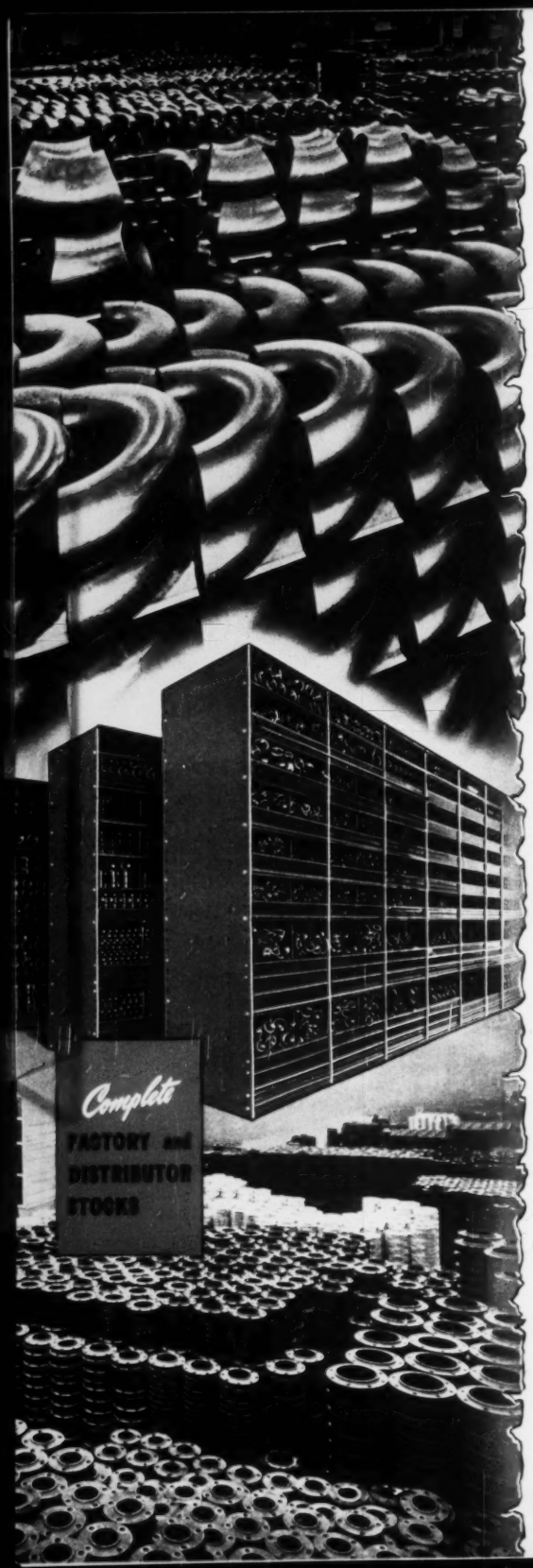
THOSE front legs are built for speed—if his rear legs can keep up the pace.

We think Rover makes a point for us. When you sell Carrier, sell Carrier all the way. No air conditioning, heating or refrigerating system is any stronger than its "weakest link." And only when the system you install is completely Carrier can you be completely sure.

That's our advice. If you follow it, there's no chance of anybody saying about one of your installations, "What kind of dog is this?"

Whenever you think of air conditioning, refrigeration or heating, see a Carrier office or installing dealer. Either will gladly work out the details of installations for you. These are a few of the Carrier products available: Conduit and Duct-type Weathermaster systems for multi-room buildings; Evaporative Condensers; Central Air Conditioners; Dehumidifiers; Self-contained Air Conditioners; Reciprocating, Centrifugal and Absorption Refrigeration Machines; Cold Diffusers and Heat Diffusers. Carrier Corporation, Syracuse, New York.

Carrier AIR CONDITIONING · REFRIGERATION · INDUSTRIAL HEATING

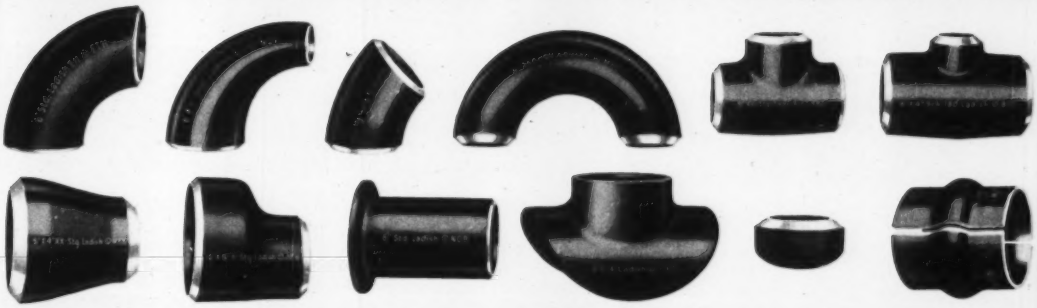


all three on one order from Ladish

TO MARK PROGRESS

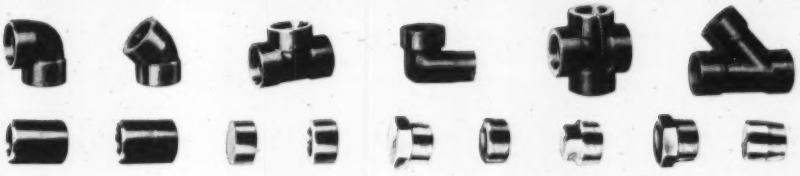
every piping system deserves the protection

SEAMLESS WELDING FITTINGS—½ INCH THRU 30 INCHES



FORGED STEEL FLANGES—½ INCH THRU 30 INCHES—LARGE O. D. THRU 96 INCHES

FORGED STEEL FITTINGS—SCREWED AND SOCKET WELDING—⅛ INCH THRU 4 INCHES



All Available in

CARBON
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STAINLESS STEELS
ALUMINUM
COPPER & OTHER NON-FERROUS METALS

Means savings in time and dollars...for LADISH offers you a complete line backed with adequate stocks

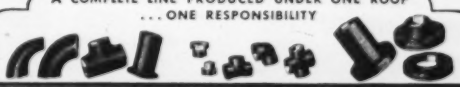
Whatever your fitting requirements . . . you can rely on the Ladish line for an unrestricted selection of Seamless Welding Fittings, Forged Steel Flanges and Forged Steel Fittings.

This Controlled Quality line is complete in types, size ranges and materials you need for virtually any application. Ladish also gives you such outstanding engineering developments to improve piping efficiency, as Seamless Reducing Elbows and Full Branch Taper Design Tees.

Adequate stocks in strategically located distributor warehouses . . . supplemented by extensive factory inventories of every type . . . give you double assurance of prompt service on every Ladish order. And, by standardizing on Ladish you know that every fitting is made to the unsurpassed standards of Controlled Quality for complete dependability.

of *Controlled Quality* fittings

A COMPLETE LINE PRODUCED UNDER ONE ROOF
. . . ONE RESPONSIBILITY



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CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland
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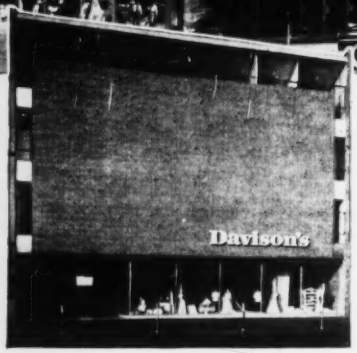
New ideas in efficient design . . .
old standards of comfort . . .
with KEWANEE® Steel BOILERS

Designed by Ketchum, Gina' & Sharp, in association with Harold M. Heatley, for Davison's Department Stores in Augusta and Columbus, Georgia; these ultra-modern buildings provide more efficient selling space at minimum cost.

A radically new single bay method of framing, with cantilevered floors, sets the supporting columns 12 feet back from the front and side walls. Columns are eliminated from the central part of the floors and small, intimate selling bays provided next the walls.



It is significant that in designing these buildings where latest concepts of functional efficiency and customer comfort are combined, Kewanee Boilers were selected to do the heating job.

Thus, today, as over a period of 80 years, the nation's leading architects and engineers turn to Kewanee Boilers when they require dependable heating for their finest buildings.

Kewanee Type "C" Boilers for mechanical firing were installed in these modern stores by Reliance Engineering Co., Charlotte, N. C.

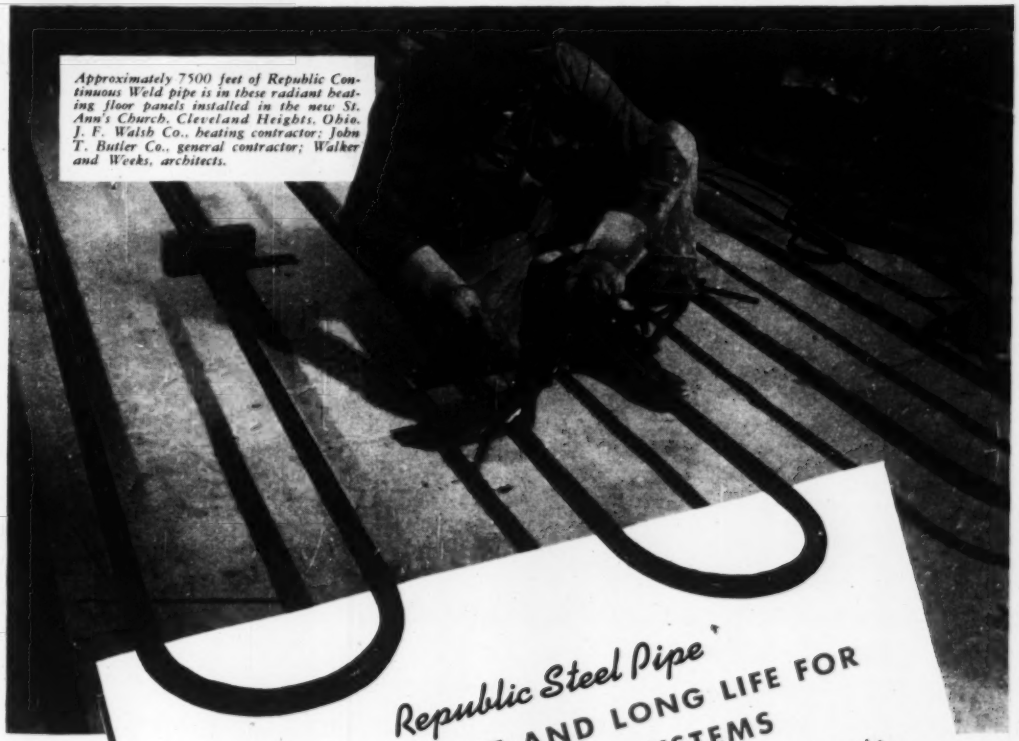
KEWANEE BOILER CORPORATION

BOILERMAKERS 80 YEARS KEWANEE, ILLINOIS

Branches in 60 Cities—Eastern District Office: 40 West 40th Street, New York City 18

Serving home and industry

AMERICAN STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON



Approximately 7500 feet of Republic Continuous Weld pipe is in these radiant heating floor panels installed in the new St. Ann's Church, Cleveland Heights, Ohio. J. F. Walsh Co., heating contractor; John T. Butler Co., general contractor; Walker and Weeks, architects.

Republic Steel Pipe MEANS LOW COST AND LONG LIFE FOR RADIANT HEATING SYSTEMS

For many years, steel pipe has been standard for closed system heating lines. Its trouble-free service has proved you need nothing more costly for closed system radiant heating panels.

Today's Republic Steel Pipe is even better than the pipe which served so well 20 years ago. Republic's *improved* Continuous Weld Process keeps it highly ductile and easy to fabricate. Made to ASTM specification A53, *it is suitable for close coiling and bending.*

It welds readily, making sound joints by all modern methods. Its long lengths speed installations by reducing the number of joints.

Yes, Republic Steel Pipe meets all requirements for radiant heating, including low first cost and long life. Your Republic Pipe Jobber will be glad to give you latest information on available sizes and current delivery schedules. See him soon.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Bldg., New York 17, N.Y.

REPUBLIC CONTINUOUS WELD PIPE

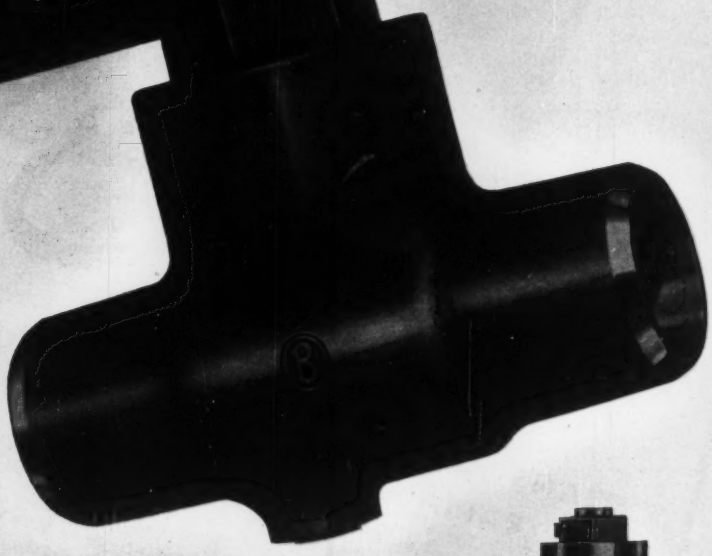
Easy to bend, thread and close coil
Easy to weld by all methods
Uniformly ductile
Uniformly strong
Uniformly clean and scale-free
Uniform wall thickness, diameter, concentricity
Economical uniform lengths, extra long lengths
Expansion co-efficient same as concrete and plaster

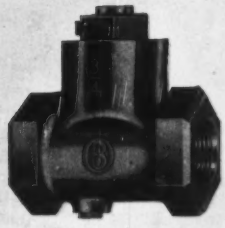
REPUBLIC STEEL

Republic STEEL PIPE

PRESENTING EQUATEMP (TRADE MARK)

NEW

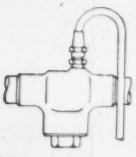




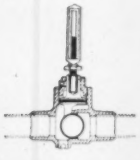
Soldered end type from ⅜ to ¾-inch size. Also available with screwed ends from ¾ to 1½-inch size.

THE NEW EQUATEMP OFFERS THESE EXTRA ADVANTAGES

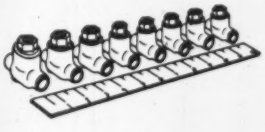
Variable Venting. Drain is provided in body of valve to permit easy draining or attachment of any of several standard venting attachments.



Built-in Thermometer Well. EQUATEMP's stem has been drilled out to provide a convenient thermometer well.



Easily Adapted for Manifolds. Where it is desired to manifold EQUATEMP valves, the small size enables eight to be manifolded in a space a foot wide.



RADIANT HEAT VALVE

PROVIDING ADJUSTABLE FLOW PLUS LEAK-TIGHT SHUTOFF

Here is the only low-cost balancing device on the market today that offers adjustable flow control plus leak-tight shutoff in *one compact valve*. This valve has been designed by Ohio Brass after carefully studying the opinions and ideas of heating engineers, contractors, builders, layout men, and architects interested in the future of hot water radiant heating. It incorporates all of the important features they considered necessary in a balancing valve.

With EQUATEMP, no expensive globe or gate valve is needed, no extra "T" fittings for thermometer well and venting attachments--just one inexpensive EQUATEMP valve eliminates these three extra items. Costing no more than ordinary steam cocks or balancing fittings normally used, this valve provides economical yet efficient balancing and shutoff control for radiant and convector hot water heating systems.

If you would like additional information, contact your local supplier of Ohio Brass valves or fill out coupon below requesting fully illustrated folder.

EQUATEMP SPECIAL DESIGN FEATURES MEAN BETTER PERFORMANCE

TAMPERPROOF STEM-LOCKING SCREW

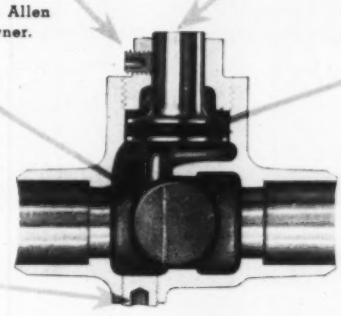
After line is properly balanced, this stem-locking screw is tightened with a 1/8-inch Allen wrench to prevent tampering by homeowner.

LEAK-TIGHT SHUTOFF

By a 90° turn of the valve stem, 100% tight seal is obtained. The synthetic rubber valve disc provides an absolutely leakproof closure under maximum operating pressure of 30 lbs. Not affected by hot water or corrosive substances normally found in water.

TAMPERPROOF VENTING

A 3/16-inch Allen wrench is needed to remove drain plug in bottom of valve. Tapped for standard 1/8-inch thread, it provides for simple attachment of several venting methods.



TAMPERPROOF REGULATION

Regulation of valve to balance line is accomplished by 7/16-inch Allen wrench inserted in socket head in top of valve stem.

LEAK-TIGHT PACKING

A synthetic rubber packing ring fits snugly against the inside walls of valve collar preventing leakage under maximum operating pressures of 30 lbs. This ring is impervious to hot water and any corrosive materials present in water.

THIN PIPE ENDS FOR EASY SOLDERING

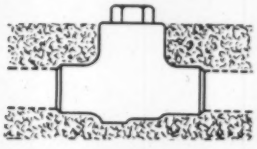
Careful trimming produces thinner pipe ends that permit fast distribution of heat, assuring an even flow of solder around the tubing and a leak-tight joint.

4021-V

Ohio Brass VALVES

OHIO BRASS COMPANY — MANSFIELD, OHIO

Buried Construction Possible. Due to special design, EQUATEMP valves can be buried up to their collars in cement or in plaster.



OHIO BRASS COMPANY
MANSFIELD 2, OHIO

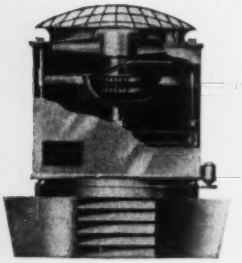
Please send me EQUATEMP Folder 862-VR.

Company .....

Address .....

City ..... State .....

Signed



The New Wing Turbine Revolving Unit Heater

This new product of L. J. Wing Mfg. Co. is the logical result of constant improvements in two specialized lines of equipment pioneered by this company.

The first Wing turbine was built as an integral part of the Wing forced draft blower over 40 years ago. The first lightweight ceiling-suspended downward discharge unit heater was introduced by Wing over 25 years ago.

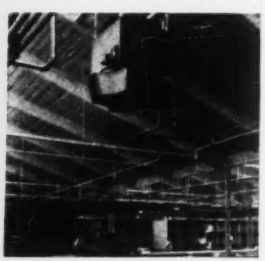
With the addition of the patented revolving discharge outlet in 1935 the next major step in the Wing program of constant improvements is the Wing Turbine Driven Revolving Unit Heater now offered.

In this, the fan is driven by the new Wing Allsteel Steam Turbine operating at any pressure, and the turbine exhaust is piped into the heater section. Thus the steam condensed in heating the air has first been used to operate the fan turbine.

Electric motor and electric power are eliminated.

Condensate from the heater is never at a temperature exceeding 170° F. even with air inlet temperatures as high as 100° F. Condensate is returned to the boiler through an open return system.

The entire unit is so designed that there is no back pressure on the turbine, assuring against leaks without the use of power-absorbing, troublesome packing. This also eliminates the need for traps and extra piping.



Only Wing Revolving Heaters Circulate the Heated Air Around Obstructions

Industrial plant heating reaches its highest peak of perfection in the Wing Revolving Discharge Unit Heater. Unlike stationary discharge unit heaters, which project heated air in one or more fixed directions, the Wing Revolving Discharge outlets move slowly through a complete arc, flooding the entire heating area with a blanket of fresh, live warmth. The gentle air motion caused by the constantly changing directions of the heated air from the revolving discharge outlets eliminates the hot blasts and chilly areas common with stationary discharge type unit heaters—creates a refreshing, stimulating atmosphere beneficial to employee morale and productivity.

Successful applications of Wing Revolving Heaters have been made in every type of industrial plant, as well as other buildings with unique heating problems. Get complete information on this modern form of unit heating by writing today for a copy of Wing Bulletin HR-5.

L. J. Wing Mfg. Co. 14th Street & 7th Avenue, New York 11, N. Y.

Factories: Newark, N. J. and Montreal, Canada

Manufacturing Licensee for Wing Unit Heaters in Western Europe

WANSON

9, rue Mogador, Paris 9e, France

222, rue Royale, Brussels, Belgium

Wing

Revolving UNIT HEATERS

Every year, more Contractors, Engineers and Architects recommend

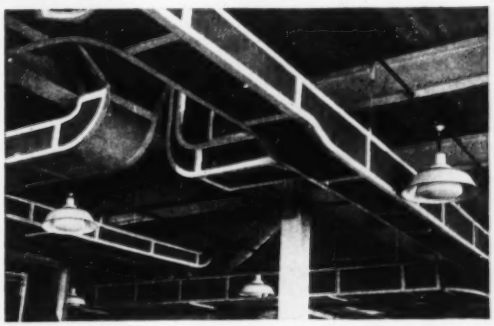
Grant Wilson
DUX-SULATION
(ASBESTOS-PROTECTED)

FOR MAXIMUM TEMPERATURE CONTROL BETWEEN SOURCE AND REGISTER OR GRILLE

ARCHITECTS specify Dux-Sulation because it increases the efficiency of ANY duct installation—from both a heat transfer and a sound deadening standpoint.

ENGINEERS know that Dux-Sulation saves fuel, delivers heat even to "hard-to-heat" areas, reduces rust and condensation problems.

CONTRACTORS appreciate Dux-Sulation's ease of application, its improved appearance—the fact that it won't chip, crack or buckle and comes complete with Dux-Sul-Glue and Asbestos Protected Tape.



Dux-Sulation is the hallmark of a modern and efficient installation. Stocked by better Jobbers in principal cities.

QUICK FACTS:

Grant Wilson Asbestos-Protected Dux-Sulation is a Thermal/Acoustical Insulation engineered specifically for duct application. With a K Factor of .27 BTU, its insulation efficiency exceeds 75%; sound absorption is approximately 61%. Rot-proof, mildew-proof and insect-proof, Dux-Sulation can be applied to either the inside or outside of round, rectangular or irregular ducts — won't chip, crack or buckle and is flexible for easy bending—½" or 1" thickness in 36" rolls about 33 feet in length. Special tape and glue (included) make installation quick and simple. Write Grant Wilson, Inc., 141 W. Jackson Blvd., Chicago 4, Ill.

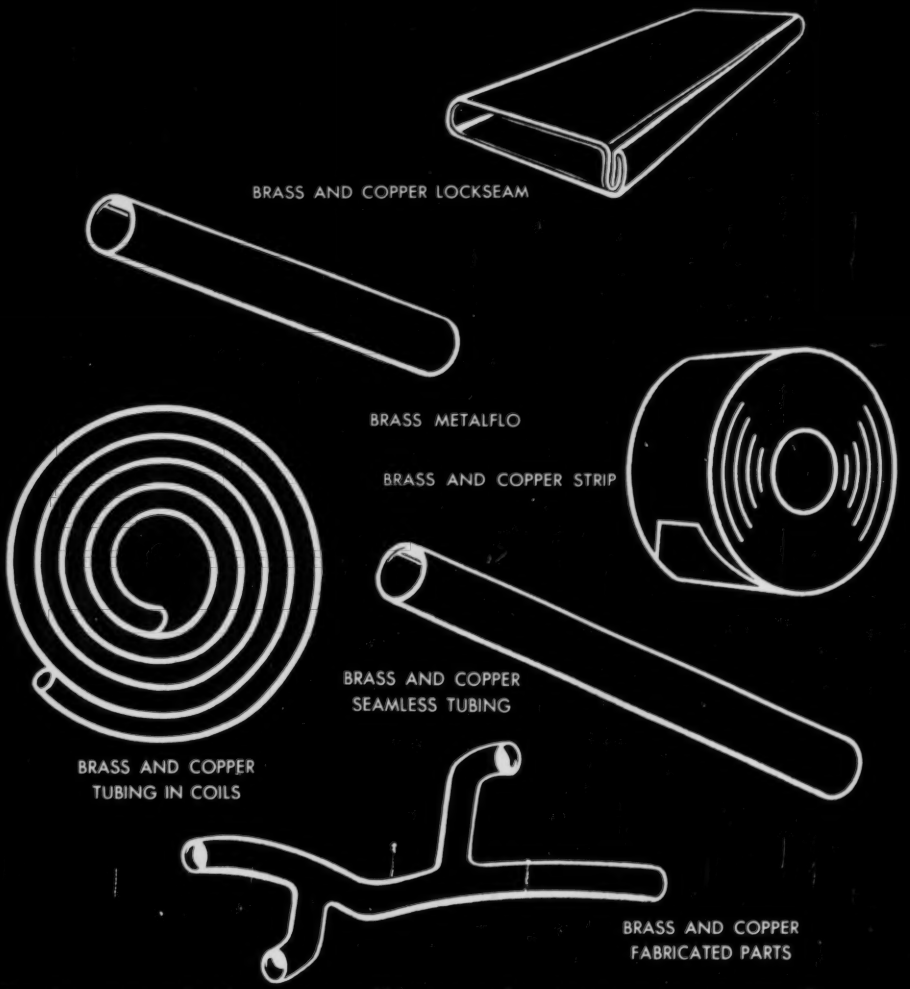
SEE FOR YOURSELF!

Send for this FREE sample

Ask for Sample Kit 2H

Grant Wilson inc.

ASBESTOS and INSULATING MATERIALS


BRASS AND COPPER LOCKSEAM
BRASS METALFLO
BRASS AND COPPER STRIP
BRASS AND COPPER SEAMLESS TUBING
BRASS AND COPPER TUBING IN COILS
BRASS AND COPPER FABRICATED PARTS

Which one of these quality products can you use?

● Is it Metalflo, the low cost tubing that's ideal where pressure is not a factor? Or is it lockseam, seamless, or strip in coils—quality tubings made in a variety of diameters, lengths and wall thicknesses to suit most purposes? And if special tubular parts, such as the one illustrated above, are one of your requirements, why not get in touch with us today? Ask any H & H customer—he'll tell you the name H & H stands for quality, prompt delivery and the lowest prevailing price, always.

BRASS AND COPPER TUBING FOR ALL INDUSTRY

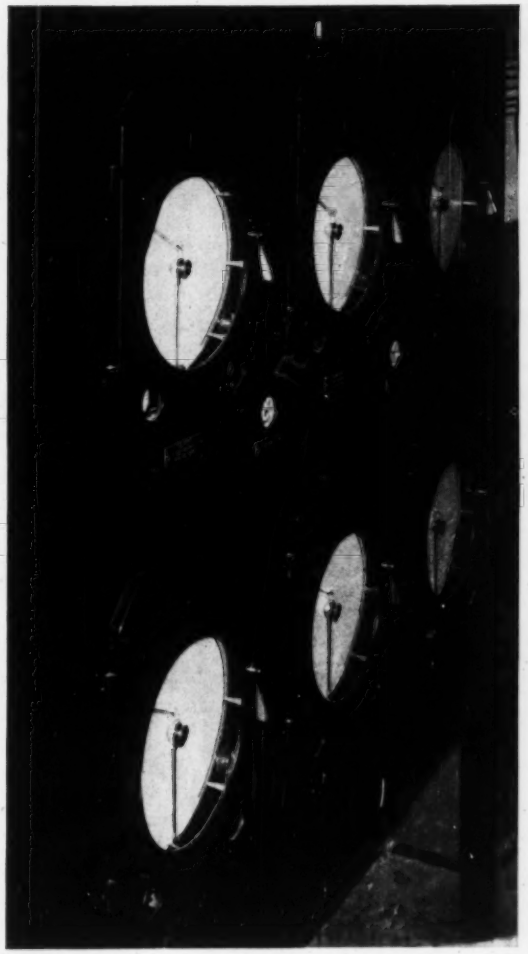
H & H TUBE AND MANUFACTURING COMPANY

245-275 N. Forman Avenue • Detroit 17, Michigan • VInewood 2-3600

METALFLO • LOCKSEAM • COIL STRIP AND SEAMLESS TUBING • TUBULAR PARTS

GOODYEAR EXECUTIVES KEEP COOL

with Taylor Automatic Dew Point Control



Taylor Automatic Dew Point Control System for executive offices of Goodyear Tire & Rubber Co., Akron, Ohio

SINCE their Akron, Ohio, executive offices were modernized, Goodyear Tire & Rubber Company executives keep comfortably cool all year round with the help of Taylor Automatic Dew Point Control. This is the most direct temperature and humidity control system available. The air conditioning job was handled by Dan H. Willis Company, a leading Akron engineering contractor. Then Goodyear called in Taylor, and we supplied the air conditioning instrumentation. A Taylor Application Engineer worked along with Willis in laying out the system—and making final adjustments.

This split system automatically supplies properly heated and humidified air to the executive offices, the adjoining secretaries' offices, Board Room and the Board Chairman's office.

This highly versatile Taylor Automatic Dew Point Control System uses:

1. Dry Bulb Temperature Controller for pre-heating outside air to a constant temperature.

2. Wet-and-Dry Bulb Controller applied to air washer for dew point and humidity control.

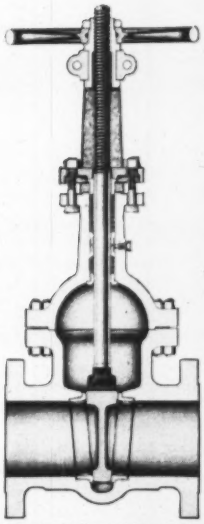
3. A summer-winter changeover controller for positioning dampers.

4. A Type-P Expansion-Stem Controller for protection against spray water freezeup.

Your Taylor Field Engineer will be glad to show you the basic principles used in the many successful Taylor-controlled large space air conditioning systems from coast to coast. Whether you need air conditioning for human comfort—or for product quality—Taylor Automatic Control will help you get top efficiency out of your equipment. **Write for Catalog 5.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

For completeness of selection You can't beat the CRANE line



No. 47XR, 150-Pound Steel Gate for steam up to 850° F., for water, oil, air or gas up to 500° F. Exelloy to Nickel Alloy seating. Sizes: 2 to 24 in.

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Crane Cast Steel Wedge Gate Valves find wide application wherever exceptionally rugged and durable steel valves are required. Body and bonnet have heavy metal sections and ample reinforcements at points under greatest stress. Straight-through ports assure minimum turbulence, erosion, and resistance to flow.

Solid wedge disc with close fitting disc guides maintains accurate seating on shoulder-type screwed-in body seat rings. "T-head" disc-stem connection prevents side strain on stem. Available in pressure classes from 150 to 1500 pounds with a variety of trim materials especially suited for recommended services. Screwed, flanged, or welding ends. See your new No. 49 Crane Catalog, p. 227.

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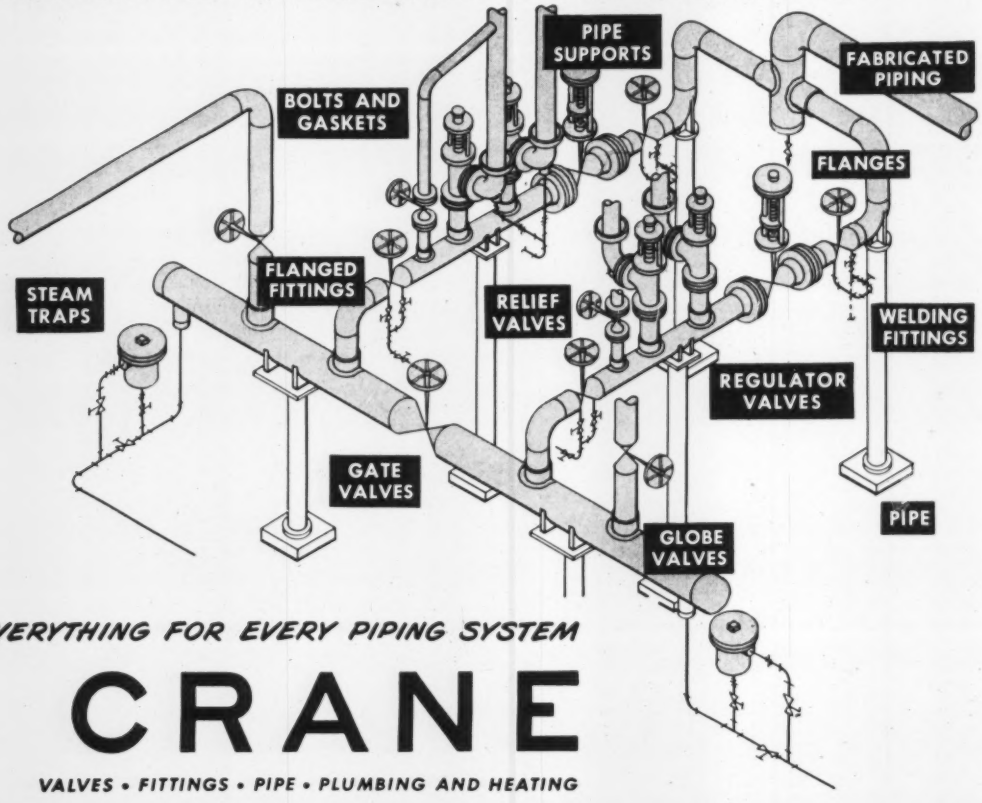
ONE ORDER TO CRANE COVERS ALL PIPING EQUIPMENT FOR THIS PRESSURE REDUCER STATION, FOR EXAMPLE



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

THE EDITOR'S PAGES

LAST MONTH's Show Section in Heating, Piping & Air Conditioning "previewed" the Southwest Air Conditioning Exposition in Dallas and the 56th annual meeting of the American Society of Heating and Ventilating Engineers in the same city. As usual, the official proceedings of the ASHVE meeting will appear in the ASHVE Journal Section, which is published each month in HPAC. . . . . Several of the papers presented at the meeting have already been published in the Journal Section, there are others this month, and the rest will follow. . . . . New products and improvements displayed at the exposition, and which have not already been described in our columns, will be covered in our regular Equipment Developments department. . . . . Last month's issue of Heating, Piping & Air Conditioning (the biggest in history, by the way) also carried the annual Directory Section, which is compiled and published for your use throughout the year. If you fail to find any information you are looking for in this Directory Section during the year, we'd certainly appreciate your dropping us a line so that we can remedy the omission in the printed Directory Section next January (and, in the meantime, possibly give you the information you seek). Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2. . . . . We think you'll like a new feature which starts this month. It's called Practical Piping Problems, by Robert C. Soronen. Based on a wide experience, he discusses flash tanks for high pressure condensate and blow-off tanks and piping. He is preparing other excellent discussions for future issues (some of them on heating and ventilation rather than piping, in which case we'll probably change the title of this editorial feature somewhat). . . . . For some reason, requests for extra copies and reprints of articles which have been published in HPAC have taken a jump in recent weeks. We handle these as promptly as we can, and regret it sincerely when—in some cases—we just don't have any available copies of a particular article remaining. . . . . Our volume index for 1949 is still in preparation, but if you have requested a copy it will be sent you as soon as it comes from the printer.

CONSTRUCTION CONTRACTS SET ALL-TIME HIGH

F. W. DODGE CORP. reported last month that contracts awarded for building and engineering works in the 37 states east of the Rocky Mountains in 1949 totaled $10,359,250,000 to show a gain of 10 percent over 1948 and to establish a new all-time dollar volume contract record in the corporation's construction news reporting regions.

Gains late in the year brought the total of nonresidential awards to within 1 percent of volume in this classification reported in 1948, the recession in manufacturing building and moderate declines in commercial building awards offsetting substantial increases in hospital and institutional buildings, office buildings and similar structures used by government agencies, educational and science building and religious building. The year's nonresidential volume was $3,643,909,000 in the area east of the Rockies.

Public agencies increased contract outlays for nonresidential building during the year by 23 percent, while private nonresidential awards dropped 11 percent from the previous year.

Residential awards established a new all-time record of $4,239,386,000 or 17 percent more than that reported for the previous year. Private residential awards increased 13 percent while awards for residential building by government agencies climbed 109 percent over the previous year and added 4 percent to the overall residential volume increase.

There was a marked upswing in multiple housing awards last year, apartment house contract volume totaling $1,121,641,004, being 59 percent higher than in 1948. Single family houses built to owners' orders showed a 10 percent increase and single family houses built by operative builders for sale or rent climbed 8 percent during the year.

Heavy engineering awards totaled $2,475,955,000 in the 37 states last year, or 15 percent more than in the previous year, with private engineering contract volume showing a 50 percent gain over 1948 and public engineering volume reflecting a 9 percent gain.

INDUSTRY TO MODERNIZE IN '50, SAYS FERGUSON

ORGANIZED efforts to reduce production costs will result in an unusually large volume of plant modernization and rehabilitation in many segments of industry during 1950, Otto F. Sieder, executive vice president and general manager of the H. K. Ferguson Co., industrial engineers and builders, said last month in the firm's annual forecast based on a survey of Ferguson representatives in major industrial communities across the country.

Construction volume in the industrial field seems certain to decline—possibly as much as 15 percent. This decline would be even more if large expenditures by the government for atomic and military facilities were not considered part of the total industrial volume.

On the other hand, the survey discloses that engineering volume will hold firm, and may even increase over 1949 figures. Two reasons are advanced:

1) Modernization and rehabilitation programs usually require greater engineering expenditures per dollar of construction than new plants; and

FRANK KOTTRA

FRANK KOTTRA, circulation manager for many years of Heating, Piping & Air Conditioning and American Artisan—both of which are published by the Keeney Publishing Co.—died suddenly and unexpectedly at home early last month.

Well-known in publishing circles, Frank was a leader in his field and a mighty fine friend and business associate. His death leaves a gap which will never be entirely filled.

THE EDITOR'S PAGES

2) Comparatively few plants were on the drawing boards in 1949. More are expected to be planned and engineered in 1950. These will not go into actual construction this year, however, since engineering is generally a year or more ahead of building.

"The new year will reflect a pronounced search for operating economies through better design, modernized processes and integrated layout," Mr. Sieder said. "Increasingly tighter competitive conditions and advancing production costs in nearly all phases of industrial endeavor are becoming major problems for most manufacturers. Many of them are realizing that the starting point to lower production costs is a soundly engineered plant."

Studies by the company indicate that many modernization programs will involve moderately large dollar expenditures. Typical programs will consist of the installation of labor saving devices such as automatic control instruments, advanced materials handling systems, and the replacement of piping systems, tanks, electrical systems and other major items of equipment which have been in constant use to fill a decade of war and postwar demands. A large amount of building repairs and replacements is also necessary in many instances due to lack of proper upkeep during the past 10 years.

Mr. Sieder pointed out that many modernization programs will take a spectacular turn because it is sometimes more economical to construct an entirely new plant than to rehabilitate an existing facility to the desired degree of efficiency. An effort to reduce materials handling costs, for example, could conceivably result in the abandonment of a multi-story structure in favor of a single story building. In fact, there are already instances where this has been done profitably. In the chemical industry, where technological advances are sometimes likely to make existing processes obsolete almost overnight, it may be advantageous to scrap an existing process and start anew.

Ferguson district managers in all parts of the United States believe that costs will be relatively stable during the year, although "full impact of rising steel prices is yet to be felt." Prior to these increases, a slight drop in costs, not to exceed 2 or 3 percent, had been anticipated.

Several factors were said to be working in favor of lower costs. First is that competition and abundance of supply is bringing down the cost of certain building materials. Second is that productivity from labor is on an upward swing. A third is that deliveries for most items are again predictable and enable builders to schedule their operations more effectively than in the past several years.

The absence of the "haste element" is also conducive to reduced building costs, according to the study. Manufacturers are allowing their projects to remain in the planning stage much longer and more time is allowed for economical buying. Generally, more time is allowed for actual construction.

Additional points in the annual forecast:

The backlog of wartime industrial buildings for sale by the War Assets Administration is practically depleted. Numerous companies which otherwise would have bought these structures at reduced prices—often at the expense of economical operation—will have to expand their own plants.

Many large corporations are building modern distribution facilities on a nationwide basis. Some have programs calling for a dozen or more warehouses and assembly plants. One reason for decentralization is that freight rates have risen to the point where they are now a major item of cost.

"QUOTE"

"WHEN WE USE the word 'comfortable' with respect to heat, we are really saying 'my skin is at the right temperature.'

"The human thermostat has a double job. First, to hold the internal body temperature near 98.6 F, and, second, to keep the skin near 92 F. The temperature of the Garden of Eden must have been near 85 F as this is the air temperature at which the nude body has its normal skin and deep body temperatures. We can understand from this that the average suit of clothes has an insulation value equal to about 15 or 16 F of temperature. That is, we may go back and forth between two adjoining rooms at 85 and 70 F respectively, with a constant and comfortable skin temperature provided we remove our clothes as we enter the warmer room.

"It is thus clear that it is a physiological sin to wear clothing at temperatures above 85 F."—L. P. HERRINGTON, of the John B. Pierce Foundation and Department of Public Health, Yale University, at a Climate Control Forum sponsored by House Beautiful magazine.

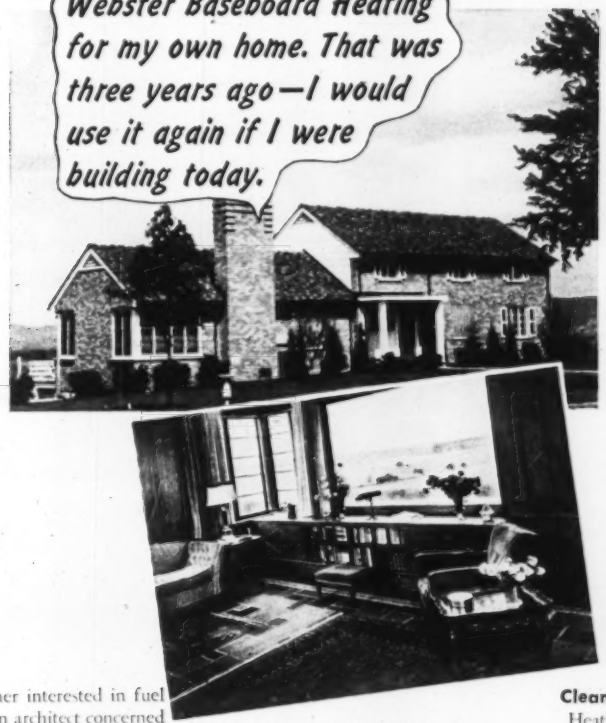
How Much Heat From Laboratory Animals?

YOU ARE INVITED *to answer the following question from a reader of HPAC. Suitable comment on the matter will be welcomed and —space permitting—will be published and paid for at regular rates. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

"We are engaged in the design of an air conditioning system for an animal laboratory, and have little data on the heat given off by rats, rabbits, mice, guinea pigs, etc. We would appreciate any information that may be available, and particularly would like data on the proportion of latent to sensible heat."—G.C.

[Some figures which have been published in HPAC were sent "G.C." but it is believed that additional data should be made generally available.—ED.]

As an architect, I selected Webster Baseboard Heating for my own home. That was three years ago—I would use it again if I were building today.



FIRST IN THE FIELD
Webster
BASEBOARD HEATING
TRUE PERIMETER HEATING

As a home owner interested in fuel economy, and as an architect concerned with over-all appearance and design, W. Marshall Hughes is enthusiastic about Webster Baseboard Heating.

"After three heating seasons, I have found that Webster Baseboard Heating uses less fuel than estimates submitted on all other types of heating. Webster Baseboard Heating gives me more uniform comfort and cleaner heating than any system I have used."

Modern, Uniform Heat

Webster Baseboard Heating is perfected hot water heating installed behind a specially-designed metal baseboard around the exposed walls of a room.

Residence of W. Marshall Hughes, A.I.A., Wyomissing Hills, Reading, Pa. Architect: W. Marshall Hughes. Builder: W. M. Hughes & Son, Inc. Heating Contractor: Corbit's, Inc.

Webster Baseboard Heating is *clean* heat, *convected* heat . . . *radiant* heat in its most practical form. Tests have shown *less than 2 degrees variation* from floor to ceiling. Heat is adequate even in sub-zero weather.

With Webster Baseboard Heating, you have complete freedom in arranging furniture. There's nothing to interfere with drapes or furniture. No chance of scorched, soiled or dried-out furnishings.

Cleaner, More Economical Heat

Heating is always gentle and mild but fully adequate with Webster Baseboard Heating. Air enters at floor line, passes over finned copper heating element, is warmed, and flows out of the top of the baseboard, supplying constant, even circulation. Fuel consumption is at a minimum.

Webster Baseboard Heating is suited for individual residences, row houses or garden apartments. Fuel can be gas, oil or coal. Webster Baseboard Heating is a development of Warren Webster & Company, an organization with a record of more than 60 years leadership in heating systems.

Leading heating contractors right now are building their business plans around Webster Baseboard Heating. Let the Webster Representative in your locality give you further details.

Address Dept. HP-2, Warren Webster & Co., Camden 5, New Jersey
Representatives in Principal Cities : In Canada, Darling Bros., Ltd., Montreal

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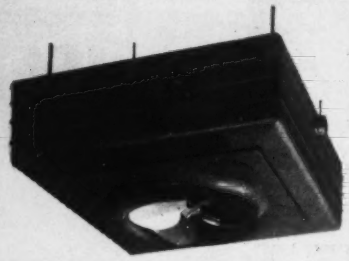
BASEBOARD HEATING

NEW DESIGNS . . . IMPROVED PERFORMANCE



Little Giant Down Blow Unit

Little Giant Horizontal Blow Unit

WEBSTER-NESBITT present further advances in their well known line of industrial and commercial unit heaters. These improvements result from continuing engineering research by the manufacturer, John J. Nesbitt, Inc., and year-round field study by the extensive organization of the distributor, Warren Webster & Co. W-N Unit Heaters —backed by two reputable companies—are your double assurance of heating satisfaction.

LITTLE GIANT UNIT HEATERS. Downblow units, combining wide selectivity and versatility of application. Seven basic sizes, with a choice of two (in the two largest units, three) heating elements. Capacities, at basic steam ratings, from 23,900 to 348,000 B.t.u.

The three smallest sizes are blow-through type, for vertical down-blow, with outlet velocities suitable for lower mounting heights.

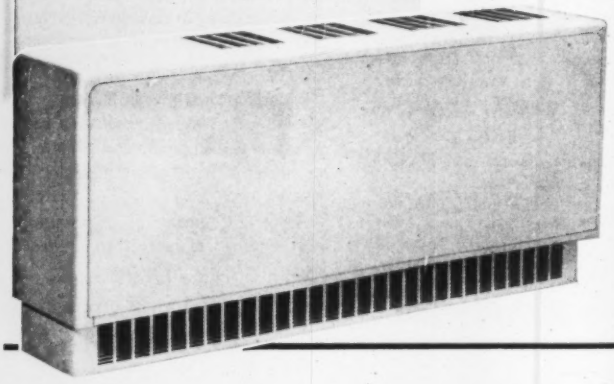
The four larger models are draw-through type, for vertical or horizontal downblow, with high discharge velocities for high mounting and blowing long distances. Publication WN-134.

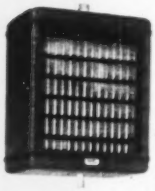
SERIES R UNIT HEATERS. Cabinet type, centrifugal fans, belt-driven unit heaters for quiet operation and flexibility of application to steam or hot water. Four unit sizes: two, three, four, or five fans. Steam heating capacities from 158 to 588 e.d.r. Air deliveries, 518 to 1890 c.f.m. May be installed as a vertical floor type, a horizontal type, a wall type, or an inverted type of unit. Modern in design and finish. Publication WN-133.

PROPELLER-FAN UNIT HEATERS. Rugged, compact, suspended types. Capacities from 34,700 to 358,000 B.t.u., basis steam ratings. Publication WN-126.

GIANT UNIT HEATERS. For large interiors and large air-handling. Floor, wall, ceiling types; nine sizes, 2,580 to 16,350 c.f.m. at final temperature, and 101,000 to 1,008,000 B.t.u. Publication WN-128.

Series R Cabinet Type Unit Heater





• Consult your telephone directory for the nearest Warren Webster & Co. representative, or write to the Camden, N. J. office.

Webster Nesbitt
UNIT HEATERS

MADE BY JOHN J. NESBITT, INC., PHILA. 36, PA.
SOLD BY WARREN WEBSTER & CO., CAMDEN, N. J.

"OPEN FOR DISCUSSION"

Do YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to contribute your views on some other matter of interest to heating, piping, and air conditioning engineers or contractors? We follow here the custom at engineering society meetings of allowing a period for discussion following presentation of a paper. You are invited to contribute your comments. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

MYTH OF THE "INDOOR SUN"

CONGRATULATIONS to F. W. Hutchinson for a thoroughly technical yet easily understandable article, The Myth of the "Indoor Sun," in the December HPAC. While we have promoted the term "radiant heating" in this country, we have always objected to claims that a radiant heating system actually warms the human body by means of the radiation which strikes the individual. Some promotion (by others), of the ceiling system in particular, has been based on a comparison with the sun and we are on record against such theories (HPAC, February 1948, p. 100). However, the term "radiant" is not necessarily a misnomer, for warm floors, walls and ceilings do have a greater radiant effect than other systems in that they regulate the bodily heat loss by radiation to an apparently more comfortable rate. While we like the term "radiant heating," I feel there are so many more important problems to be solved that I have so far been reluctant to take time to enter into a discussion of what the proper term should be.

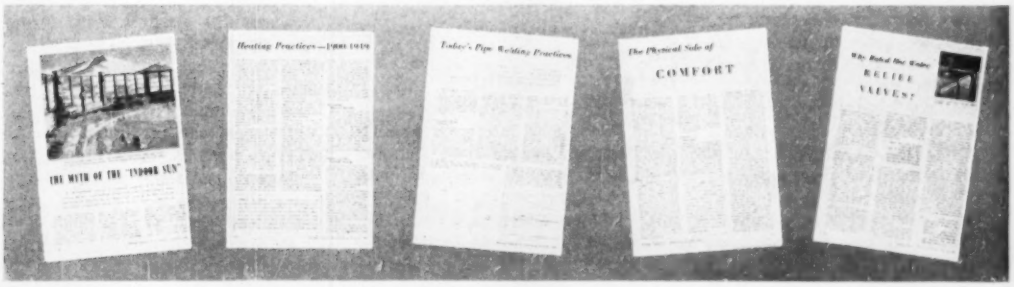
Professor Hutchinson's article is not intended to include a discussion of the merits of floor, wall and ceiling surfaces for heating purposes but I do believe that indirectly he has cleared up some of the misunderstanding that has developed recently. It appears that some favoritism is being shown for the ceiling system because it is claimed that the ceiling provides a more efficient radiating surface. The fallacy of such a theory is that since the emissivity of a concrete floor and a plaster ceiling are so nearly equal, the radiation from each must be equal also at the same temperature and in the same environment. Actually, the ceiling is considered an efficient radiator only because it is so inefficient a convector! And when total heat output from the two surfaces at the same temperature is compared, the ceiling is substantially *less* efficient. There are other factors to be considered, of course, and whether the ceiling or the floor is to be used in a specific case cannot, in my opinion, be decided on such a flimsy basis as percent of heat transfer by radiation.

This brings me to the point in Professor Hutchinson's article where he states:

"Fortunately, a capably designed panel heating system does the very thing that its most rabid advocates want it not to do: it provides effective distribution of convective heating and hence is a method of raising the air temperature within an enclosure and of thereby establishing occupant comfort through general space heating. On this basis and in this way, panel heating does an effective job."

It could be gathered from these statements that "radiant heating" is not anything different or unusual and that it simply is a method of providing "effective distribution of convective heating." In all fairness to "radiant heating," I believe the author should have pointed out that the very general term "effective" encompasses a number of advantages which are not immediately discernible to many readers.

While "effective distribution" obviously includes uniformity of air temperature and warmth at floor level (particularly with floor type systems in basementless structures), the desirable conditions which exist while the "distribution" is taking place are not quite so apparent. Air velocities, for example, are low and result, in the case of a well designed system, in elimination of noticeable drafts. "Effective distribution" is also obtained with low surface temperature and thus low air temperatures. The "freshness" of the air reported by so many owners of radiant heating systems can undoubtedly be attributed to the ability of a radiant heating system to produce comfort with air which never comes in contact with any heating surface over 85 deg to 90 deg in the case of a floor system, or slightly higher in the case of a ceiling system. Thus, while heating



"OPEN FOR DISCUSSION"

panels serve primarily to distribute heat by convection, the conditions created during the distribution of the heat and the net effect in terms of comfort are unique, and "radiant heating," "panel heating" or whatever you may wish to term it, must be considered a different and new method of heating even if it does fall short of being an "indoor sun."—PAUL S. PARK, manager, engineering service dept., A. M. Byers Co.

HOT WATER RELIEF VALVES

REFERRING TO THE article by John James, entitled Why Rated Hot Water Relief Valves? published in the December HPAC, it is our very definite opinion—based on a quarter of a century of experience in the manufacture of water relief valves for hot water boilers—that water pressure relief valves should be constructed to harness pressure without relieving too quickly and should be capable of increased relieving capacity in direct relation to the rate of expansion and pressure rise. Diaphragm type valves do this. Too slow operation or insufficient relief capacity will permit pressure to build up while quick opening or excessive relief capacity will reduce pressure too rapidly with consequent waste of water resulting in too much pressure drop.

Pressure in a hot water heating system increases relatively slowly. Relief should be in proportion and not greater than necessary. We do not consider a quick, full opening water relief valve safe or proper. A dangerous condition from flashing into steam could occur if high temperature water under pressure in a hot water boiler were suddenly and too rapidly expelled.

We do not believe water pressure relief valves should be installed at the hottest point. Pressure is equal at the same level throughout a closed hot water heating system. We believe the relief valve should be installed in the return piping close to the boiler to protect the valve and its working parts from high temperature.

The successful operation and safety record of quality diaphragm type relief valves over the many years they have been used attest to their dependable operation and practicability.—PAUL F. THOMPSON, executive vice president, H. A. Thrush & Co.

THE PHYSICAL SIDE OF COMFORT

I WOULD LIKE TO compliment A. C. Menke and C. L. Ringquist on the care and effort they are putting in to preparing the material published in your magazine and called The Physical Side of Comfort.

This physical or physiological side of air conditioning, the close relationship between comfort and health and the relationship of the body to its environment, are all things that the air conditioning engineer must understand.

As you look back through the literature you find that there has been a constant effort on the part of mankind to understand his environment better and then to control it. It seems to me that great progress has been made during the last few years and greater progress will be made in the next years. These articles are well done and worthy of the attention of everyone working with air for human comfort.

Thanks to HPAC for publishing them.—LESTER T. AVERY, president, Avery Engineering Co., and newly-elected national president of the American Society of Heating and Ventilating Engineers.

HEATING PRACTICES EARLY THIS CENTURY

I HAVE READ with interest the article by Samuel R. Lewis in the January HPAC on heating practices during the early years of this century.

Mr. Lewis and I must have entered the heating field at about the same time, for the early practices which he describes are very familiar to me. Some of these, like the low pressure steam engine fan drives, the setting of the horizontal return tubular boilers 24 in. above the grate, the use of air heating coils constructed of steel pipes screwed into cast iron bases, etc., had been in use well before the turn of the century.

I recall that in 1898 we were installing the horizontal return tube boilers 48 in. above the grate level. We were making use of cheese cloth air filters of the bag type and wood frame type shortly after 1900.

At that time the use of header type $1\frac{1}{4}$ in. pipe coils placed below the level of the window sills on the exterior walls was very prevalent in school room heating.

Also, about that time the merits of the "split" system versus the "blast" system of school heating became something of a battle royal.

Mr. Lewis well describes the early days of subatmospheric steam heating systems as of the year 1900. I recall that some contractors used an ordinary needle valve on the return connection at the radiators. The use of cold injection water in the receiving tank was frequently necessary to produce a vacuum. The development of modern vacuum heating involved a period of many years.

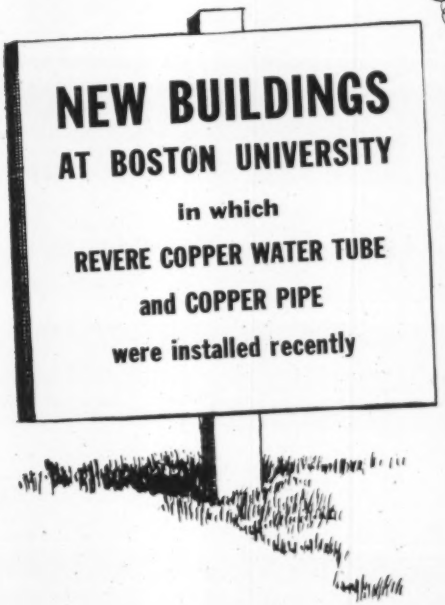
There is little more that I can add to the excellent review offered by Mr. Lewis.—DWIGHT D. KIMBALL, consulting engineer, member of HPAC's board of consulting and contributing editors.

PIPE WELDING PRACTICES

TODAY'S PIPE Welding Practices, the articles by F. C. Fantz in November, December and January, represent a very timely contribution to published information.

The subjects given individual consideration are very well treated. However, the greatest merit stems from the fact that Mr. Fantz writes in a very understandable style and gives in the complete article an over-all summation of many things which have been publicized individually in various forms. Thus, the complete article will provide readers with a compact, handy, compilation of useful data and ideas.—G. W. HAUCK, manager, engineering sales, Crane Co.

Cram and Ferguson, Architects-Engineers;
C. H. Cronin, Inc., Plumbing Contractor.



MORE than 10,000 feet of Revere Copper Water Tube, in sizes from ⅜″ to 4″, and a similar amount of Revere Copper Pipe, from ½″ to 4″, were installed recently in four new buildings at Boston University.

Revere particularly welcomes the opportunity to supply materials for buildings where long life and low maintenance cost are of first importance. For such installations take full advantage of the long-lasting qualities of copper.

Because copper is non-rusting it costs less in the long run . . . and architects, engineers and contractors are finding that Copper Water Tube provides many economies during installation.

All Revere Copper Water Tube is stamped at regular intervals with the Revere name and the type. These marks are more than identification—they are your assurance of full wall thickness and the close dimensional tolerances so essential for tight soldered joints.

It will also pay you to install such other long-lived Revere materials as Red-Brass Pipe; Sheet Copper and Herculoy for tanks, ducts, pans and trays; Dryseal Copper Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere Distributors in all parts of the country. The Revere Technical Advisory Service is always ready to serve you. Call your Revere Distributor.

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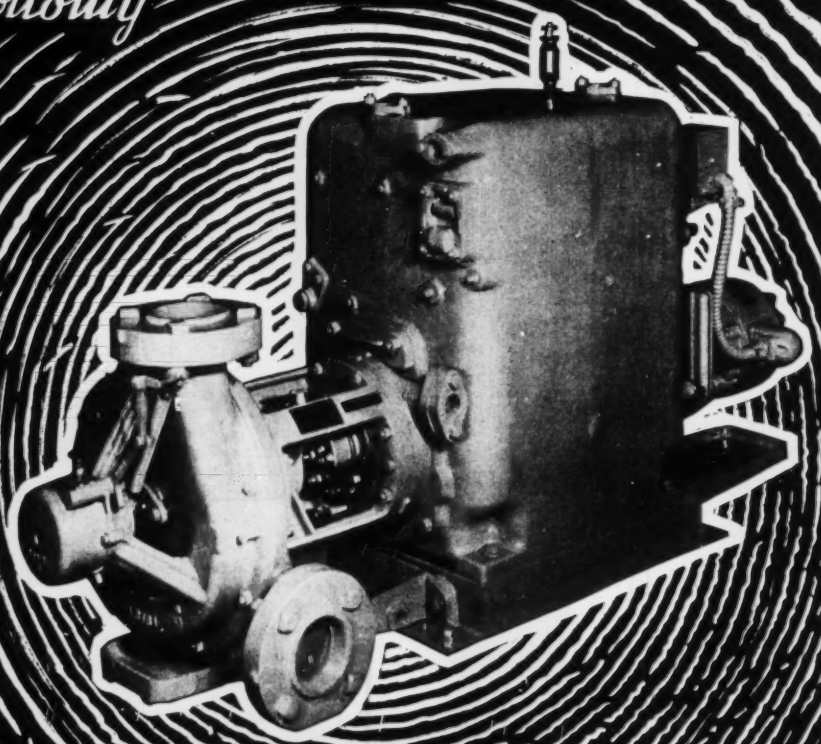
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Storage Air Conditioning System

Boosts Attendance at Big Church

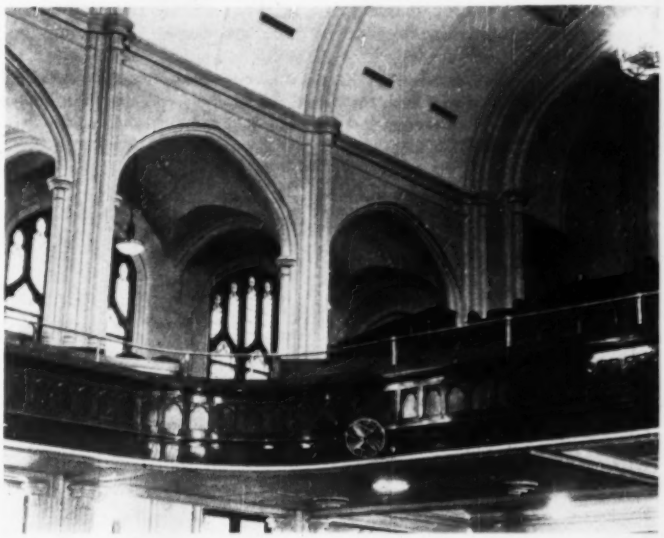
DAVID C. PFEIFFER, consulting engineer, discusses the low annual air conditioning load factor for churches and the selection of a refrigeration system to improve the situation. He describes the storage air conditioning installation placed in operation last year at the First Methodist church in Dallas—which was put in to meet the problems of decreased summer attendance and loss of membership to churches in residential areas. Data on electrical consumption and cost of air conditioning of the installation are included. Results have been most satisfactory

FACED WITH a problem of decreased summer attendance due to the weather—and loss of membership to churches in residential areas—the First Methodist church, in downtown Dallas, decided to air condition the sanctuary (auditorium) and part of the Sunday school rooms. A year 'round system for comfort control was installed and was in service last summer; results have been most gratifying in increased attendance at Sunday morning and evening services, and at social meetings, banquets, and other church activities during the week. In fact, attendance has been on a level equal to that during the normal busy winter season.

The average church, due to its low annual load factor, presents special air conditioning problems. There are approximately 20 to 25 Sundays during the year when weather conditions such as those in Dallas warrant air conditioning for a period of possibly 2 hr per Sunday for Protestant churches and a longer time for Catholic churches. This extremely poor load factor makes it difficult to justify the installation of standard conventional systems for such short operating periods.

For this reason, most churches have investigated other means for the refrigerating capacity necessary for comfort cooling. It is, of course, possible to obtain some degree of comfort by good ventilating systems, but many installations of this type, normally satisfactory for residential work, have often been entirely inadequate and disappointing for church use. The usual high ceilings and large volumes make it almost necessary to blow air directly on the people, at the same time keeping air changes to not less than three minutes and preferably one minute. Such systems, when properly installed, are better than nothing, but noise and appearance often make them undesirable. For the same reasons, evaporative cooling, either direct or indirect, has not always been successful for church applications.

The conventional types of air conditioning systems (involving the control of air temperature, humidity, cleanliness, adequate outdoor air, and proper air distribution) should be employed for church installations with the same care as used for the most satisfactory commercial installations—with the exception that greater care should be used in the air distribution system for minimum noise levels so as not



Rear view of auditorium showing method of air distribution for balcony and ceiling outlets for first floor under the balcony

Summary of heat gain calculations

Location	Total	Number of people	Internal sensible	Internal latent	Heat from outside	Outdoor air (cfm)	Total air circulated	Unit No. served by	Tons capacity of units
Main Aud. (Sunday)	926,400	2400	951,400	440,500	534,000	12,500	43,300	A.B.C.D.	180
Main Banquet	380,360	400	168,660	83,700	128,000	3,000	7,670	E	30
Aux. Banquet & S.S.S.	319,197	285	162,353	62,200	94,650	2,050	7,370	F	27
Texas Room & W.S.S.	355,210	200	223,816	55,000	82,590	1,000	10,150	G	30
Ladies Parlor	192,075	100	128,975	22,000	41,100	500	5,860	H	20

to create objectionable noise during periods when quietness is essential.

Three different means for producing the desired refrigeration effect are employed in the various types of churches in the Dallas area. The first method is to use purchased ice delivered to bunkers and over which water is pumped to produce the chilled water for the air conditioning system. The second is to employ a conventional refrigerating system for chilled water or direct expansion coils. The third method is the storage system, which is used at the First Methodist church.

Three Methods for Refrigeration

For churches where the use of air conditioning is limited to Sunday morning services only, and where a qualified operator is not available for refrigerating machinery, the use of purchased ice will usually prove economical. For churches using the air conditioning system throughout the week, it may prove more economical to install a refrigerating plant, provided the installation costs and purchased power cost are reasonable. A church desiring the use of air conditioning for its auditorium at any time, and particularly for all-day meetings, should probably install a complete conventional system having sufficient refrigerating capacity to carry the maximum load continuously.

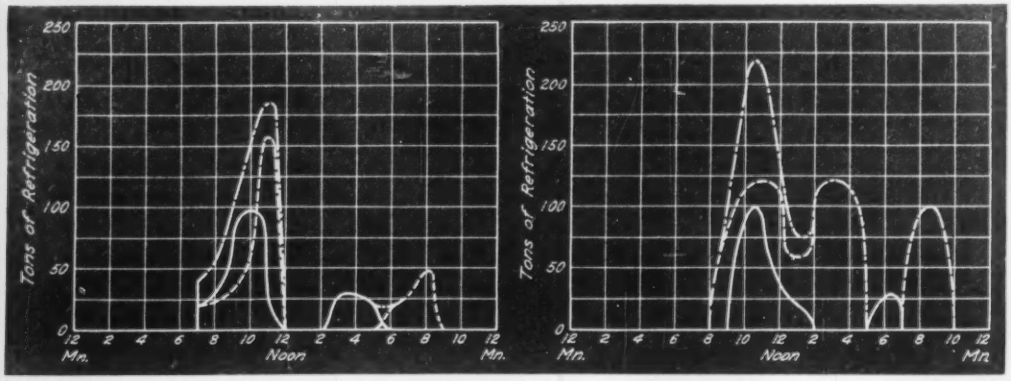
The storage system represents a compromise between the least expensive purchased ice system and the most expensive conventional compression system. The storage idea consists of using a small refrigerating plant and providing means for storing refrigeration in some form (chilled water, or ice accumulated on coils or plates, etc.) so that the necessary quantity will be available to meet the maximum demands.

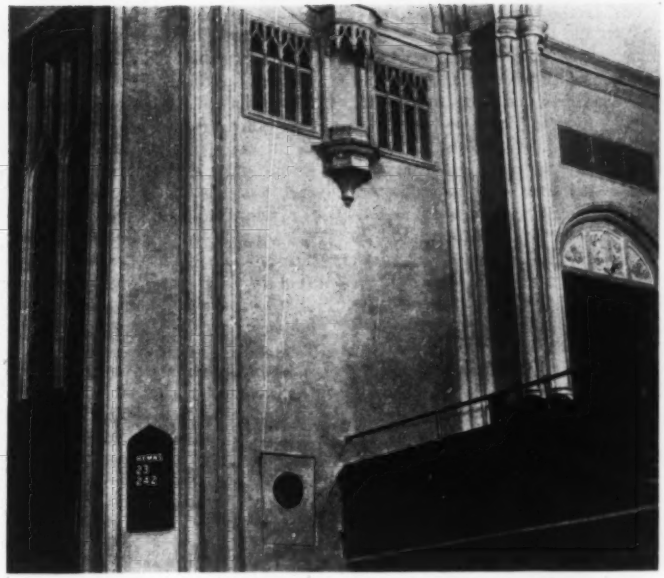
The obvious advantages of this type of system are lower installation cost than for a conventional system, and lower power cost than for the conventional system due to a reduction in demand charges because of the smaller equipment. The disadvantage of this type of system, compared with the conventional type, is that it introduces a time element in the operation of the air conditioning system and must be carefully designed for a given load curve. For example, a church desiring a storage system designed for a normal 2 hr morning load and a 2 hr evening load could not expect this system to operate satisfactorily for an entire day for some special occasion. Means can be provided to supplement such a system by purchasing ice for these occasions but unless this is done the church should fully realize this limitation to the storage system.

To justify the storage system as compared with purchased ice, it must be used for a considerable part of the week. It is cheaper from a standpoint of operating costs to produce the necessary refrigeration than it is to purchase ice, but from a standpoint of fixed charges on the additional investment it would be considerably more expensive to install refrigerating equipment and not use it. The proper recommendation for the most economical and efficient system can be made only after analysis of the air conditioning loads of the area to be served, a careful study of the times during the week when these areas should be served, a study of the existing electric power rates, the cost of purchasing ice, and the cost of help to supervise operation.

***Left*—Typical Sunday refrigerating load, the solid curve representing the Sunday school load, the dotted line the auditorium load, and the dash-and-dot line the total load curve.**

***Right*—Conference Sunday load curve, the solid line representing the Sunday school load, the dotted line the auditorium load, and the dash-and-dot line the total**





Front view of auditorium, showing the grilles for conditioned air. Those at the lower left of the picture serve the choir, and the front quarter of the auditorium is served by the grilles in the ornamental openings at the top. At extreme upper right is a return air grille

Of 25 air conditioned churches in Dallas, 14 are of the conventional type, six the storage type, and five use purchased ice. Of the 14 conventional systems, five are above 50 hp. The six storage installations represent three which use ice formation on coils or plates and three which employ chilled water storage. Of the five churches which purchase ice, two are very large (2400 seating capacity) and three are medium size.

Auditorium Has Four Zones

The First Methodist church is one of the largest in Dallas, having an auditorium with a seating capacity of 2400 (approximately 1800 on the lower floor and 600 in the balcony). In addition to the main auditorium, there is a Sunday school building larger than the sanctuary divided into rooms for Sundays and banquet or meeting rooms for weekday use which is not conditioned at present. The air conditioning system serves the complete auditorium or sanctuary and the entire basement area exclusive of the kitchen.

The conditioned areas are served by a water circulating system using chilled water for summer cooling and hot water for winter heating. The air distribution system is handled by factory-built air conditioning units consisting of fans, filters, coils, etc. The main auditorium is divided into four zones, the front part of the church, including the choir loft, pulpit and approximately one-third of the first floor area being served by two air handling units located in rooms in the east and west parts of the building. The rear two-thirds of the first floor and the balcony are served by two air handling units located in the area under the balcony. For normal Sunday services, all four units are in operation—each being controlled by a separate thermostat to take care of shifting sun load to give a uniform temperature. For special occasions, such as weddings, funerals, etc., front units only may be used which will condition the front half of the auditorium very satisfactorily.

The basement area is divided into four zones, which are separate meeting places. Each is served by an individual factory-built air handling unit. The basement area is divided so that it can be used for banquets as desired and any part operated independently of the other. Outdoor air to each unit is manually controlled.

Water Circulating System

Two water pumps are arranged so that in summertime they circulate chilled water through the piping system. The operation of all eight air handling units is controlled from one central control board so that it is convenient to stop or start any unit without going to the particular area. Motor operated valves are provided at each unit so that if desired the water circulation can be shut off through any unit. These valves are interconnected with the winter thermostatic control to prevent possible overheating by air leakage through the coil with the face damper closed. For summer operation, the piping is arranged so that chilled water is taken from the storage tanks and piped through the system. A thermostatically operated three-way valve controls the temperature of the water going to the units, it being arranged so that if colder water is desired more water will be taken from the tanks and less from the return line.

For winter heating, the tanks are cut out of the system and water is pumped through a steam converter or hot water heater. In winter a separate thermostat controls the

Electrical demand and consumption

		Kw demand			Kwhr			Cost		
Period	Date of Maximum demand	Total	Air cond.	Total less air cond.	Total	Air cond.	Total less air cond.	Total	Total less air cond.	Air cond.
June 22—July 22	July 10	151	88	63	19.920	13.310*	6.610	$462	$190	$272
July 22—Aug. 23	July 24	153	86	67	28.440	15.330	13.110	531	262	269
Aug. 23—Sept. 22	Aug. 28	153	89	64	21.720	13.760	7.960	480	211	269
Sept. 22—Oct. 24	Sept. 25	85†	8†	77	18.000	8.590	9.410	331	251	80

*Estimated—based on three weeks' readings. †Billing demands based on proration of actual operation.

flow of steam to the coil to maintain the desired water temperature. This unit is of the type which is automatically reset from outside temperature so that it will supply warmer water to the system when the outside temperature is colder.

Designed to Meet Sunday Load

The refrigerating system was designed to meet the typical Sunday refrigerating load consisting of a morning Sunday school load, a morning church load, and an evening load. The maximum Sunday school load is approximately 100 tons and the maximum auditorium load is approximately 160 tons. Due to the diversity of operation and the fact that the human load consists of approximately the same people, the estimated maximum is not 260 tons but approximately 185 tons. The total refrigerating load requirements for a typical Sunday is 731 ton hours. This would be the equivalent of a 731 ton system operating for 1 hr or a 73.1 ton system operating for 10 hr. For any weekday, the maximum refrigeration load for a banquet, wedding, or funeral has been estimated at 172.5 ton hours.

Actual operation has shown that the estimated Sunday load was somewhat short of the actual load in the evening as the Sunday night attendance increased from the 500 people used as a basis for the estimate to as high as 1500. The system was actually designed for 880 ton hours and there has been no difficulty during the summer in maintaining comfort conditions.

The refrigerating plant consists of two 25 hp radial compressors with conventional circulating water pumps and an induced draft cooling tower. Sixteen ice accumulators are used, consisting of two banks of eight each. The two chilled water pumps are so arranged that one compressor with eight accumulators and one chilled water pump can be operated entirely independently of the other. The refrigerating plant is entirely automatic, the compressors being operated from suction pressure so adjusted that they will automatically shut down when the ice thickness reaches the desired amount. The relation between ice thickness and suction pressure is sufficiently accurate so that no serious difficulty has been experienced.

As the system was designed for a normal Sunday load, it cannot satisfactorily operate for the entire day on consecutive days as sufficient time is not available to produce the necessary quantity of ice. For operating during the annual Methodist conference, when several thousand preachers and laymen gathered for a five-day meeting, it was necessary to buy additional ice to supplement the ice making capacity of the refrigerating system. A load curve taken during this conference, plotted from actual operating data, shows a total load of 1540 ton hours for this particular day. Had purchased ice been used for this day, it would have been necessary to purchase approximately 60 tons of ice which, at $5 a ton, would have cost $300. The actual ice purchased on this particular day was 10 tons, which supplemented the system during the afternoon and evening.

Bids were taken on three types of systems—purchased ice, storage refrigeration, and a conventional system using a centrifugal compressor. In all cases, the chilled water and air handling systems were the same and it is reasonable to assume that the comfort conditions would be the same in each case. The lowest bid for the conventional system was $138,000, for the storage system $100,000, and for the purchased ice, including an ice bunker, $80,000. The estimated cost for operation was approximately $600 a year for the fans and pumps common to each system, $800 a season for the power cost for the storage system, $1300 a season for the power cost for the conventional refrigerating system, and $2400 a season for purchased ice.

Results the First Season

Actual experience during the first season of operation indicates that the system is being used considerably more than was anticipated. It was originally anticipated that the refrigerating plant would be used only a few hours in advance of requirements for meetings but these have come at such frequent intervals that it has been necessary to keep the refrigerating system in continuous operation. During one week in the latter part of August, the air conditioning system was used on 11 different occasions.

The actual power cost has averaged approximately $60 a week, of which approximately $40 could be charged for Sunday operation and $20 for the additional use throughout the week. Almost every week, the system was used four or five times in addition to Sunday.

The comfort conditions in the church have been most satisfactory. While records of larger collections resulting from increased church and Sunday school attendance are not available, it is certain that they are most gratifying.

The author served as consulting engineer for this air conditioning installation, and the air conditioning contractor was Matthews Engineering Co. T. E. Freeman is operating engineer of the First Methodist church and assisted in preparing this article.

In the interests of cost, ducts in the Sunday school area were not furred but were installed beside existing beams and painted to match

POWER PIPING PRACTICE.....1900-1950

A. G. CHRISTIE, emeritus professor of mechanical engineering, Johns Hopkins University, well-known authority on power plant design, was first represented in HPAC's pages in May 1929 with an article on piping for high pressures and temperatures. Recently, we asked him to compare briefly power piping at the turn of the century with today's practices, and this month's article is the result. In summary, he mentions the use of much higher pressures and temperatures, welded connections, and alloy steels

GREAT PROGRESS has been made during the past half-century in the design and fabrication of piping for power plants. Improvements have been made each year so that one is apt to overlook the extent of the changes that have occurred in these 50 years. This progress perhaps can be best appraised by contrasting practices in 1900 with those now current.

"High Pressure" Plants at 175 Psig

Steam pressures in 1900 were generally in the range of 80 to 150 psig, although a few "high pressure" plants operated with pressures of 175 psig. Superheat was rarely used—and when used, seldom exceeded 50 F above saturation temperature.

In general, steam piping carried wet steam and this consideration influenced all designs of piping systems. There was the ever-present danger of damage to pipe lines from water hammer, and to engines if water was carried over into the cylinders. Pipe line drainage was a major consideration. Pipes were installed with sufficient slope in the direction of steam flow to drain all water in the lines to pockets from which it could be trapped. Drainage in a direction opposite to steam flow might cause water hammer with resultant damage to pipe connections. Care was taken in locating valves on steam lines from boilers, or in the main headers themselves, so that little or no water could collect above the closed valve as this water could cause damage when the valve was opened.

Reciprocating steam engines were in general use, as steam turbines were still under development. Steam separators were placed above the throttle valves of engines to remove any moisture from the incoming steam. Traps of many varieties and different effectiveness were in use and their maintenance was a major job of power plant operators.

Boilers and engines were both relatively small and generally each plant contained a number of both. Boiler outages for internal cleaning were frequent. Hence, steam headers were installed into which the boiler leads were connected and from which the pipe connections were run to the engines. These pipe connections generally contained bends to provide for expansion. Such an arrangement involved many valves with their accompanying maintenance.

Standard weight piping sufficed for the prevailing pressures. Pipe lines might have screwed or flanged joints. Flanges were of cast iron and were threaded onto the pipes. Leaks frequently occurred at these connections. Valves had cast iron bodies and often cast iron discs and seats. No boiler code was in existence and practice varied in regard to boiler construction and piping connections. Generally, only one valve was placed between the boiler outlet and the main steam header.

A favored practice of designers was to provide a large header to even out steam flow and to locate this header at a high elevation in the boiler room. Valves at this header could only be reached by ladders or a more or less adequate walkway.

The cutoff of the reciprocating engines often induced pulsations in the steam lines. Resulting pipe vibrations usually caused leaks at the pipe joints. Gaskets were generally made with a rubber base and as these materials tended to harden in service, their useful life was short requiring frequent renewals. Flanges had flat faces, raised faces or occasionally male-and-female joints. Steam pipes were sometimes placed in closed trenches in the floor and exhaust pipes were commonly so located. It was difficult to get at flanged joints in trenches and maintenance under such conditions was a time-consuming and costly task.

Wet steam caused leaks in the seats of globe and gate valves. Frequent repairs and renewals were necessary if reasonably good operation was expected. Welding was not used for such repairs and various kinds of plugs or inserts were used where valve seats had been cut by the wet steam.

Pipe expansion was not great at

the temperatures in use and this was generally cared for by bends. Some slip joints were in service.

Little thought was given to the suspension of piping and to the provision of suitable anchor points. These details were generally left to the judgment of the pipefitter or millwright.

Duplicate steam headers and ring systems were occasionally installed but these required more maintenance than single headers and were abandoned in later practice.

Boiler feed piping was subject to two troubles, scale deposition and corrosion. Raw water was quite generally used for boiler feed as condensate was contaminated by cylinder oil. Few attempts were made to pretreat this raw water outside of the boiler. Boiler compounds of various compositions were added at feed pump suctions to prevent the formation of hard scale in the boilers. The result of such treatment was generally a deposition of scale in the feedwater piping itself. Such scale could only be removed by boring out the pipes and this often meant dismantling the pipe line.

Corrosion of feedwater piping systems was due to the fact that deaeration was unheard of and the effect of dissolved oxygen in the feedwater on metal surfaces was little understood. The consequent wasting-away of feed pipes and valves fell under the classification of an "act of God."

Flange dimensions had been standardized for the standard weight pipe which served for steam pressures up to 150 psig. But standard dimensions had not been agreed upon for center-to-face and face-to-face distances in fittings. Hence, elbows, tees, and other fittings varied in size between the several manufacturers. Ordinary carbon steel bolts could be used in flanged joints at the steam temperatures in use. Extra heavy pipe, while available, was seldom used in steam plants. Seamless tubing was used occasionally for boiler tubes. Welding of piping as now practiced was unknown in 1900.

Pipe covering materials could be had but were in general not as effective as those now in use. One frequently found piping in small plants with no covering whatever and, as a consequence, heat losses were high.

Judged by present standards, piping practice in 1900 was crude, the materials employed were suitable for low steam pressures only, and frequent troubles from leaks and corrosion resulted in outages of equipment and comparatively high maintenance costs.

Power piping practice today differs from 1900 in the use of much higher pressures and temperatures, welded connections, and alloy steels

Turbines Up Pressures, Temperatures

In order to appreciate fully the changes that have been made during the past 50 years in power piping practices, one should consider some of the events that brought about these changes.

The introduction of the steam turbine in power plant service after the first of the century led to the use of higher steam pressures and temperatures. Troubles developed in cast iron valves and fittings due to their so-called "growth" at temperatures above 450 F. As a result, steel flanges, fittings, and valves came into use for piping systems with superheated steam. Standards were adopted for center-to-face and face-to-face dimensions of fittings for both standard and extra heavy pressure services. The general acceptance of the ASME boiler code also influenced piping designs.

Increased pressures and temperatures led to the development of improved flanged joints of steel. The effect of creep on the relaxation and stretch of carbon steel bolts first used in flanges, together with temper embrittlement, became evident in numerous bolt failures. This led to the use of bolts of alloy steels capable of withstanding without creep the necessary stress to keep the joint tight. These bolts were often of the stud-type, threaded at each end for nuts. In large diameter turbine flange bolts a hole in the center permitted the insertion of an electric heater to heat the bolt to a desired elongation. The nuts were set up snug and the bolt allowed to cool when the necessary stress to keep the joint tight would be developed in the bolt.

Even with these improved joints and alloy bolts, trouble was often experienced due to uneven heating-up of the wide flanges in warming up a pipe line. Also, these special flanged joints and their bolts were expensive. This, together with the difficulty of keeping joints tight, led to the use of welds for all piping joints. Present practice is to weld all main steam lines. Flanged joints are still used, of course, on some low pressure installations.

The advantages of welding power piping include compact arrangement of piping systems, tight piping, lower costs of heat insulation, and no bolts that may relax and stretch in service.

Standard practices have been developed for the control of welding. Pipes are preheated to specified temperatures before welding is started. Qualifying tests are given to welders to determine their ability to make a safe and reliable weld. X-ray or gamma ray examinations are made of large pipe welds to insure soundness. One method of making this test is to cut a hole in the pipe adjacent to the weld through which a small grinder may be inserted to smooth-up the interior of the weld. The outside surface of the weld is also ground smooth and to a uniform diameter. A radium capsule is then placed in a holder at the center of the pipe and at the weld section. A photographic film is wrapped around the outside and exposed for the necessary time. Any defects in the weld, as shown on the film, are chipped out and re-welded. When the joint

is satisfactory, the hole in the pipe is closed by welding in a piece of pipe or other suitable closure device. Welds are finally annealed by electrical heaters and under controlled conditions—together with 8 to 10 in. of piping on either side of the weld. This annealing is to correct any internal stress resulting from the heat of the weld.

Gas welding was used extensively on early pipe joints. At present, gas welds are used only for initial tack welds of some piping joints. The joint is completed with electric arc welding. When the pipe can be turned, the electric welding may be automatic.

Piping welds are usually of the butt type. Seal rings are used at the welded joints of small pipes to prevent welding icicles inside the pipe. Most designers use seal rings on large pipe welds; a few prefer to machine the abutting pipe ends so as to contact tightly at the bottom of the weld. Several tack welds are made at the bottom to retain the pipes in close contact and the weld then filled with metal. No icicles can form inside the pipe if the abutting ends remain tight. The objection to icicles is that these may break off later from high steam velocities and damage turbine blading.

Valve bonnets should be removable to permit repairs to discs and seats. Bolted joints under these bonnets have been hard to keep tight with high pressures and temperatures. Metal gaskets of both the flat and ring types have been used in these joints. Some employ a joint which is seal-welded to assure complete tightness. Alloy bolts must be used on all high temperature valves. New types of valves are available which have pressure-sealed bonnets with no bolts required to keep the joint tight.

Central Stations Use Unit System

Many steam central stations are planned on the unit system of one boiler-one turbine. There is no interconnection of the units, as the availability factors of modern boilers and turbines are practically the same. Since there is no interconnection, no non-return valve is needed on the boiler outlet nor is the usual shutoff valve on the boiler steam pipe necessary. The omission of these valves results in a reduction in piping costs when high pressures and temperatures are used. The combined throttle and automatic stop valve at the turbine is the only valve on the high pressure steam piping of the unit. This valve must be designed to withstand the inspector's test pressure on the boiler.

Pressures alone have developed no particular difficulties in pipe lines provided the pipe, fittings, valves, and joints are of proper strength for the operating pressure. Steam pressures up to 2400 psig are in daily use. However, high steam temperatures have required much development of piping materials. Total steam temperatures up to 1050 F are employed in central stations. The tensile strength of all ferrous materials falls off rapidly after a temperature of about 600 F is exceeded. The phenomenon of creep—that slow, indefinite stretch of metal at high temperature and stress—asserts itself to an increasing extent as the temperature rises. Creep, if allowed to continue, results in rupture of the pipe. Carbon steels creep readily at high temperatures. Consequently, the use of carbon steels is limited to piping systems with total temperatures not exceeding 800 F.

Criteria governing the selection of piping materials for temperatures above 800 F are dimensional stability, corrosion resistance, and freedom from graphitization. All of these characteristics become of greater importance as temperatures increase. Alloy steels must be used to meet these requirements. Molybdenum tends to lessen creep. Chromium increases corrosion resistance. Columbium and titanium im-

University Has New Heating Plant

THE NEW *$1,383,000 heating plant at Southern Illinois university, Carbondale, is the first completed structure in the institution's program of physical plant expansion and the first building the university has constructed since 1928. Three boilers—one being a standby—capable of producing 99,000 lb per hr of steam have been installed.*

prove the metallurgical stability of piping alloys. Piping for temperatures up to 1000 F may contain 2.25 percent chromium and 1 percent molybdenum.

A stainless steel with 18 percent chromium, 8 percent nickel has been used for temperatures above 1000 F. Piping and fittings of this alloy have to be forged to shape and bored to size, thus making it expensive. It is difficult to weld. Also, it presents difficulties in differential expansion when in contact with another alloy. A special joint for such a connection is used in the new Sewaren station [see HPAC, October 1949, p. 104, and November, p. 61]. Some designers prefer to use an alloy with 9 percent chromium and 1 percent molybdenum for temperatures above 1000 F, rather than the 18-8 stainless steel.

Graphitization Appears

Graphitization appeared in the piping used in some of the first central stations with steam temperatures in the neighborhood of 900 F. The iron carbides in the steel broke down slowly in service and stringers of graphite were formed in the interior of the pipe walls. These graphite inclusions greatly reduced the strength of the metal and would have ultimately led to failure with further graphitization.

The private utilities financed extensive research to determine the causes that led up to this formation of graphite. It appears that excessive use of aluminum in killing the liquid steel after pouring from the open hearth furnace is the primary cause of graphitization, and it is now recommended that aluminum for such use should not exceed 0.5 to 1 lb per ton of steel. The addition of chromium and molybdenum in the quantities noted above also lessens the tendency toward graphitization. In some cases, the complete piping systems of central stations were replaced when evidence of graphitization was found in the original piping. Piping systems of all large stations are under constant observation to detect any evidence of graphitization.

Since the tensile strength of carbon and alloy steels decreases with increased temperature, pipes have thick walls. The expansion of such thick pipes with high temperatures leads to many problems. If bends are used to take up this expansion, the total length of piping is increased which thus increases the total expansion to be cared for as well as the first cost of the piping. Some designers provide straight runs of main steam piping from the steam generator to an elbow in the basement of the plant, which serves as a fixed anchorage. A similar straight run connects the elbow to a point near the turbine throttle valve. A multiplicity of pipes of small diameter and with liberal bends to take up the full expansion in the main steam pipe connect the superheater outlet and the turbine throttle valves to the main header. Other designs use a straight run of full-sized pipe from a fixed anchorage at the superheater outlet to an elbow or bend in the basement which is free to move, and more straight pipe to another fixed anchorage at the turbine throttle valve. The normal flexure of this all-welded pipe system is relied upon to provide for all expansion between anchorages.

Boiler feed and blowoff piping may be subject to high pressures but not to superheat temperatures. Such piping can therefore be made of carbon steel of suitable thickness for the particular pressure. Deaeration and pretreatment of feedwater have lessened the troubles earlier experienced with oxidation and scale in boiler feed pipes.

Valves with welding ends are available both in carbon and alloy steels for all services. The internal design of such valves has been improved to lessen pressure drop and to prevent seats from becoming loose. Valve discs and seat rings have stellited seats for high pressures and temperatures.

Pipe supports embodying springs of such strength as required to provide for expansion are now available. These are given careful study to fix the right proportions of the springs.

High pressure pipes have drains to remove moisture when heating up. Drips are led to a receiver from which they are discharged by a pump or by an orifice to a clean well.

Pipe covering materials of known conductivity are now available for all services. Proper covering can reduce heat losses to small amounts. Frequently the covering is painted a distinctive color to identify the service to which the piping is put.

Low pressure and exhaust piping is generally welded. Large cast iron pipes and valves are used in cooling water pipe lines to condensers.

Oil pipe lines are generally made of welded steel. Such piping must be carefully cleaned of mill scale before use.

In summary, power piping practice in 1950 differs from that in 1900 in the use of much higher pressures and temperatures, welded connections, and alloy steels. One can say with assurance that piping systems of 1950 are better constructed and required less maintenance than those in use in 1900 and that many improvements will still be made in future years.

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MARCH 15 DEADLINE FOR ENGINEERING SURVEY

MARCH 15 is the closing date for the nationwide survey of selected engineering personnel sponsored by the Engineers Joint Council for the U. S. Office of Naval Research. After processing by the American Society of Mechanical Engineers, contracting agent under an ONR agreement, the questionnaires sent to full members of 18 national engineering societies will be kept in Washington as a source file of the nation's key engineers and scientists.

A national asset, the body of facts gathered by the survey will be available to government agencies, private industrial, educational and professional society planning groups, and for other legitimate purposes.

Those who have not yet answered the questionnaire are urged to do so before the deadline so that they may be listed among engineering resources of the nation. The survey was initiated as the result of a conference held in Washington late in 1948 attended by EJC representatives and those of many other engineering agencies, at which the need was discussed for a list of key engineers working in research, development and other scientific projects, who could be called in on a full or part time basis to work on the broad scientific programs of the national military establishment.

The Physical Side of COMFORT

A. C. MENKE and C. L. RINGQUIST, air conditioning engineer and manager, respectively, air conditioning department, The Trane Co., present a simplified discussion of the various factors affecting physical comfort. This discourse was prepared to clarify and explain the background and, hence, the results given in comfort standards widely used in the engineering field

WITHIN THE ZONES of body cooling, vasomotor regulation and evaporative regulation, which were described in the November issue, the specific physiological factors determining the magnitude of convection, radiation, evaporation and storage are modified by such variables as humidity, air movement, acclimatization, clothing, sex, age, wall temperatures and physical activity. The physiological factors connected with heat flow to the skin surface have been reviewed previously. In the following sections the factors of insensible perspiration, sensible perspiration and skin temperature are included in the discussion of the variables which affect them.

Humidity

Variation in relative humidity has direct influence upon the evaporative heat loss from the body, and it may indirectly modify the heat losses by convection and radiation. The equation for the evaporative heat loss has the following form:

$$H_e = K_e A_e (P_s - rh \times P_a) L$$

The evaporative heat loss is a function of the difference between the vapor pressure of the skin, P_s (the saturation pressure at skin temperature), and the vapor pressure of the air, $rh \times P_a$ (relative humidity times the saturation pressure at dry bulb temperature). The factor K_e is the constant of proportionality and varies with the air movement; the area, A_e, represents the effective evaporative surface area; and the latent heat of vaporization, L, is taken as that of water at skin temperature.

Actually, the influence of relative humidity upon body heat loss is much less important than indicated by the above formula, because the effect is mitigated by physiological adjustments. In the regions of vasomotor regulation and body cooling, heat regulatory mechanisms re-establish a new body surface temperature to compensate for changes in relative humidity so that the body heat loss remains constant. The effect is especially noticeable at very high and very low humidities. At high humidities more blood is shifted to the skin to accomplish an increased convective heat loss by raising the skin temperature. This effect which is more apparent in the extremities than other sections of the body is reported in several references [Investigations on the Interchange of Energy Between the Body and its Environment, by Charles Sheard, Marvin Williams and B. T. Horton; ASHVE Transactions, Vol. 43, 1937, p. 115; Humidity as a Health Factor in Air Conditioning, by F. W. Hutchinson; Heating and Ventilating, Vol. 39, April 1942, p. 22; Temperature Regulation, by J. C. Scott and H. C. Bazett; Annual Review of Physiology, Vol. III, 1941, p. 107.]

At very low humidities the opposite adjustment occurs; the skin temperatures may even drop below the air temperature due to withdrawal of blood from the skin and to rapid evaporation of insensible perspiration. This phenomenon [reported in The Relationship Between Total Heat Exchange and Blood Flow in the Hand at Various Ambient Temperatures, by R. E. Foster, B. G. Ferris, and R. Day; American Journal of Physiology, Vol. 146, 1946, p. 600.] was again noted at the extremities where the greatest amount of insensible perspiration occurs.

Dr. Winslow [Physiological Influence of Atmospheric Humidity; ASHVE Transactions, Vol. 48, 1942, p. 317] reports that within the zones of body cooling and vasomotor regulation an increase of 20 to 25 percent in relative humidity is necessary to compensate for the variation in body heat loss associated with only 1 F change of air temperature. In these zones (below 84 F) the sweat secretion is a minimum. This insensible perspiration is not glandular in origin but is due to a physical process, probably the diffusion of the tissue fluid through the epidermis. Dill [David Bruce Dill; Life, Heat and Altitude; Harvard University Press, 1938] mentions that those humans who have no sweat glands can discharge as much water by insensible perspiration as do normal subjects.

In the zone of evaporative regulation (above 84 F), the human body shows a remarkable power of adaptation so that by increase in glandular secretion of sensible perspiration the evaporative cooling keeps pace with the need for heat dissipation. Upon exposure to a warm environment the skin blood vessels dilate to facilitate the passage of heat to the body surface. Continued exposure activates the sweat glands which flood the body surface with water, increasing the evaporative heat loss until at 93 F and above all the body heat is dissipated by this means.

When the physical conditions permit an evaporative balance, the relative humidity of the atmosphere seems to have no appreciable influence upon the magnitude of evaporative loss. This would imply that the equation for H_e given above does not hold for evaporation occurring at the body surface. Ac-

tually, the equation is valid, indicating that if the surface of the body is maintained at the same characteristics, there would necessarily be less evaporation—and thus variable heat loss with higher relative humidities. Constancy of evaporative heat loss with varying relative humidities is maintained, however, by an increased secretion of sweat, thus increasing the effective area for evaporation—a process nicely adjusted to maintain evaporative heat loss at the desired level.

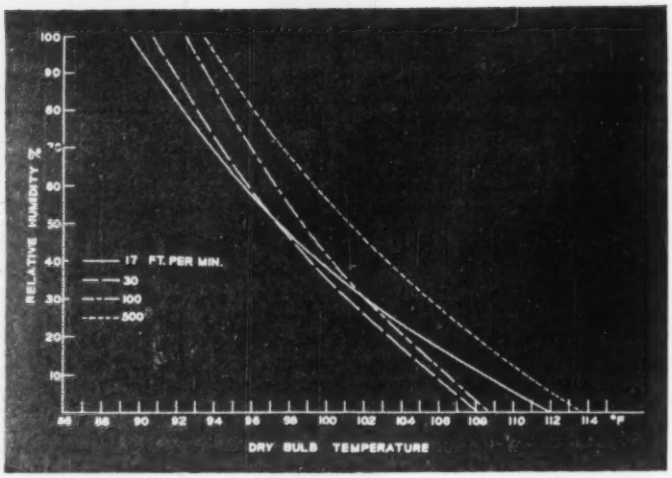
The steady increase in evaporation with higher air temperatures is not related to any parallel increase in skin temperature. The increased blood flow bringing heat to the skin surface is balanced by the increased cooling effect of evaporation on the surface of the body, and thus the skin temperature remains practically constant.

In conclusion, there is little effect on the *total values* of the thermal interchange quantities because of wide variation of relative humidity, though complex physiological adaptations will occur in order to maintain constancy of conditions. This does not necessarily mean that relative humidity has no influence on health and comfort; for example, low humidity may predispose to nervous and respiratory trouble according to some investigators. The net effect of humidity on health has not been evaluated. Present practice indicates an optimum range of relative humidity from 45 to 50 percent and an extreme range of 30 to 60 percent.

Air Movement

In the calorimetric studies conducted at the Pierce foundation and at the ASHVE research laboratory, the air movement was approximately 15 to 25 fpm. Air moving with random direction and within this velocity range was designated "still" air.

These studies showed that air movement will always increase heat loss due to convection. Evaporation in the zone of body cooling (a region of insensible perspiration) will not be greatly influenced. Radiation will not be affected directly, but as the skin temperature is influenced by changes in air movement, the radiation heat loss or heat gain will vary correspondingly. Winslow [The Influence of Air Movement Upon Heat Losses From the Clothed Human Body, by C.-E. A. Winslow, A. P. Gagge and L. P. Herrington; The American Journal of Physiology, Vol. 127, No. 3, October 1939, p. 505] found the effect of air movement on total heat loss to vary with the square root of the air velocity for both clothed and nude subjects.



Contour chart showing limits of evaporative regulation for various air velocities (from ASHVE Transactions, Vol. 44, 1938, page 185)

The body's ability to influence the skin condition in order to reduce the increased convective loss due to more rapid movement of air is very slight. Such change as does occur is due to involuntary reactions, such as the rising of hair follicles accompanying the phenomenon of "goose pimples." By this device, nature arranges to trap a stagnant layer of air in the mass of risen hair and thereby reduces heat loss.

The influence of air currents upon the upper limit of possible evaporative regulation (Pierce data) is illustrated in the accompanying "contour chart." An increase of air movement consistently increases the limits of evaporative cooling when relative humidity is high and air temperature low. When the relative humidity is low and the air temperature is high, an opposite effect occurs and an increase in air velocity actually decreases the heat tolerance. This occurs because the increase of convective gain overshadows the increase of evaporative loss. Additional air movement is undesirable when the air temperature is higher than the body surface temperature and relative humidity is less than approximately 50 percent.

When rapid air movement occurs locally, the condition is known as draft. While this is true in a literal sense, in a comfort sense "draft" is understood to mean any thermal change which is responsible for a localized change in the feeling of warmth. Drafts due to variations in temperature and motion were investigated by the ASHVE laboratory some years ago. The definition of draft used in these tests was that the average healthy adult occupants of a comfortable room would experience a 10 percent reduction in the sensation of comfort.

Results of the test indicated that the neck is very much more sensitive to draft conditions than is the ankle. Ankle draft was experienced when the local air velocity exceeded 165 fpm while the sensation of a neck draft occurred when air velocity was above 60 fpm. Drafts caused by changes in air temperature (with no velocity difference) required 8 F temperature reduction for the neck and 4 F temperature reduction for the ankle.

Acclimatization and Shock

Acclimatization to different atmospheric environments in different parts of the world and to the seasons of the year in any locality manifests itself by gradual body

adjustments which change the individual's perception of conditions for comfort. The body undergoes a progressive physiological acclimatization in accordance with normal climatic changes. In adjusting to warmer conditions, metabolism decreases, skin and body temperatures decrease, blood volume increases, pulse rate increases, peripheral blood circulation increases, salt content of perspiration decreases and the critical temperature of onset of sensible perspiration increases.

Most observers agree that acclimatization to a particular condition requires one to two weeks but that the time can be shortened if physical work is performed. If light work were done, Robinson [Rapid Acclimatization to Work in Hot Climates, by S. Robinson, E. S. Turrell, and S. M. Horvath; American Journal of Physiology, Vol. 140, 1943-44, p. 168] found that improvement in temperature regulation during the first three days amounted to 80 percent of the total acclimatization accomplished in 23 days.

Presumably a repartition of heat losses by radiation, convection and evaporation is eventually achieved in a new environmental condition which imposes the least body strain.

Similar to acclimatization, but occurring during a brief interval, is the condition of shock which is attendant upon passing from a conditioned to a nonconditioned environment. The less the disturbance of the partitions of heat loss necessary to maintain thermal equilibrium in two different environments, the less the shock experienced in passing between them. Within a single physiological zone (see discussion of Pierce laboratory data) a sudden change of environment would not be nearly so severe as that shock associated with changing from a condition within the zone of evaporative regulation to one within the zone of body cooling. The magnitude of adjustment that the body must make may be reflected in health as well as comfort though no conclusive tests have been conducted to ascertain shock effects on the body.

In the ASHVE experiments shock was experienced without discomfort in the case of young, healthy men. While the net physiological effect of shock on all types of individuals has not been evaluated, Glickman has reported that the physiological adjustments made by young adult males and by cardiac patients [Physiological Adjustments of Human Beings to Sudden Change in Environment, by N. Glickman, T. Inouye, S. E. Telser, R. W. Keeton, F. K. Hick, and M. K. Fahnestock; Heating, Piping & Air Conditioning, July 1947, p. 101; and Physiologic Adjustments of Normal Subjects and Cardiac Patients to Sudden Change in Environment, by N. Glickman, T. Inouye, R. W. Keeton, I. R. Callen, F. K. Hick, and M. K. Fahnestock; Heating, Piping & Air Conditioning, February 1949, p. 105] on passing from a comfortable to a hot, moist environment occurred rapidly and placed little strain on the cardiovascular system. The sensation of warmth was slightly but insignificantly affected by large changes (30-80 percent) in relative humidity.

Men and Women

As previously mentioned in the discussion of metabolism, women are more efficient than men in adapting to varying environmental conditions. In the zone of body cooling they are able to increase metabolism by chemical regulation. As environmental temperatures decrease, they maintain a lower surface temperature because of greater insulating fatty tissues and decreased peripheral circulation. Consequently, insensible perspiration and convective losses are less.

In the zone of evaporative regulation, the metabolism of women decreases so that sensible perspiration begins at higher temperatures and in reduced amounts. In general, there are slight differences in every single factor of temperature regulation between men and women and in all aspects the women have the physiological advantage.

Clothing

Many investigations have been conducted, chiefly under the auspices of the U. S. Army Quartermaster Corps, to ascertain the value of clothing to alleviate the physiological hazards incident upon continual exposure to extreme hot or cold temperatures. This article, however, is concerned with the more restricted problem of the influence of clothing in the comfort or near comfort regions of environmental conditions.

In general, the trends of the partitional heat loss curves are similar; the definite points of inflection in the curves for nude subjects are somewhat masked in the curves for clothed subjects and there is a slight shifting of the temperature at which the inflections occur. The upper limit of evaporative regulation of the clothed subject is greater provided the atmospheric humidity is low. The caloric demand of an environment acts ultimately on the skin whether clothed or unclothed.

Physical Activity

Sensible heat loss for men working increases but little over this loss for men at rest. Latent heat loss for men increases rapidly with physical activity and is depended upon for maintaining a constant body temperature with varying rates of heat production.

Mean Radiant Temperature

The unvarying assumption in all the previous discussion is that the wall temperature or the mean radiant temperature is the same as the air temperature. Although not seriously investigated in calorimetric studies, the influence of varying wall temperatures is important from the standpoint of comfort.

The only direct result of changing the wall temperature with respect to a constant air temperature is to alter the interchange of heat by radiation. Indirectly, the other partitions of heat loss will be affected if the environment is to have the same caloric demand as an equivalent one in which the air and wall temperatures are the same. Mills [Ease of Body Heat Loss in Development and Function; American Journal of Physiology, Vol. 125, 1939, p. 36] points out that the usual partition of heat loss between conduction, convection and radiation channels is not a necessary physiologic condition and that the limitation of body heat loss (or gain) almost exclusively to radiant channels might be a quite desirable step. Insofar as existing data go, it seems that comfort depends largely on the sum of convective and radiant losses (evaporative loss remaining constant at a value associated with insensible perspiration), and it makes little difference whether the loss is largely by convection or largely by radiation.

DATA SHEET

Chart Aids Stoker Operation and Helps to Prevent Smoke

CHARLES J. LEHN, engineer for the Field Estate, Chicago, consulting engineer, and a member of the cleaner air committee of the Chicago Association of Commerce and Industry, presents here a boiler-room "tool" he has used in many buildings to minimize under- and overfiring and thus to abate smoke. Without the proper equipment and operating aids, no operator can be blamed for failing to achieve smokeless operation of his plant

As I was driving to my office one morning last month, I noticed four buildings discharging objectionable smoke from their chimneys. I could not help but realize what was going on in those boiler rooms.

It was a rather gloomy day, with a 40 deg outside temperature. Generally, in five and six story buildings the size of these, the boiler attendant has other duties to perform—and, with hand firing, this means periodic firing. As a result, there is objectionable smoke.

No operator can be blamed for objectionable smoke in such a building where hand firing with no automatic controls is used, and where opening and closing dampers is by-hand-and-by-guess. On a 15 to 20 percent heating day, a boiler is operated at perhaps one-third its capacity and several shovelsful of coal are fired in five minute's time, which is far beyond the capacity of the boiler to burn the coal smokelessly—especially after the furnace has cooled off by laying idle 70 percent of the time.

Having had many problems with various types of boilers, stokers and operators, I have devoted considerable time and study to overcome the evil of objectionable smoke and fly ash being discharged from our stacks with underfeed stokers as well as chain grates. In the smaller buildings, with one boiler, they are generally the return tubular type with little or no boiler brickwork as an aid to smokeless operation; even if they are well bricked to avoid smoke and fly ash, smokeless operation cannot be achieved with the controls that often accompany these installations. Operating stoker and damper equipment from one extreme to another on steam pressure changes is very bad practice from the smoke and fly ash standpoints.

With a stoker that must do, at times (depending on the weather or temperature) a 20, 25 or 40 percent job—starting and stopping at intervals with cooling-off periods and consequent overfiring—it is almost impossible to control the smoke problem. With underfeed or ...der type stokers, I have found that operating the fan or blower independently from the fuel feeders and running the blower continuously, with the stoker cutting in and out on a 2 to 3 oz variable in steam pressure, prevented over or under-firing. It was found further by this method of operation that the fire or coal feed was well maintained in line with the percentage rating requirement. In this way, the fuel bed is always hot and ready to burn the small amount of coal delivered into the furnace from time to time. In either type of firing provisions should be made to permit overfire air from the blower through the bridgewall so that air delivered by the fan under the grates will also furnish some overfire air through the holes in the bridgewall. With this method of operation little or no change is necessary in damper operations.

As the fuel or ash builds up on the grates, retarding air flow, the fan air pressure will also rise, and at the same time as this pressure builds up less air may go through the fuel bed but more air is discharged over the fire and to a great extent offsets the lack of air that should otherwise come through a heavy fuel bed. This method of operation has been very helpful in retarding the smoke and fly ash evil.

To simplify chain grate stoker operation, I made up the accompanying chart. It indicates the grate height or fuel bed entering the furnace, from 4 to 10 in. With the known speed of the stoker, in inches per minute, there is indicated the lb per min of coal that will be delivered into the furnace.

Use of Chart Explained

Following the dotted line, which indicates a 5 in. gate, this line crosses the $3\frac{1}{2}$ in. stoker speed line and indicates 60 lb per min of coal. Assuming the evaporation to be 7 lb of steam per lb of coal, 60 lb per min times 60 min equals 3600 lb per hr of coal. 3600 times 7 equals 25,200 lb per hr of steam.

If the draft is such that it will burn this amount of coal, then the only variable draft required is the difference in the draft necessary to burn coarse or fine coal.

25,200 lb per hr of steam is approximately 730 boiler horsepower. Let us assume we have a 100 hp variable load, which is 3450 lb per hr of steam. 3450 divided by 7 equals 493 lb per hr of coal, or an increase or decrease of 8.2 lb per min of coal.

60 lb per min plus 8.2 equals 68.2 lb per min or a grate speed of 4.0 in. per min according to the chart. Thus, an increase of 0.5 in. per min stoker speed will take care of 100 hp.

This may be accomplished either by a longer fire, by the increased speed, or a slight increase in draft to burn 8.2 lb more coal per min.

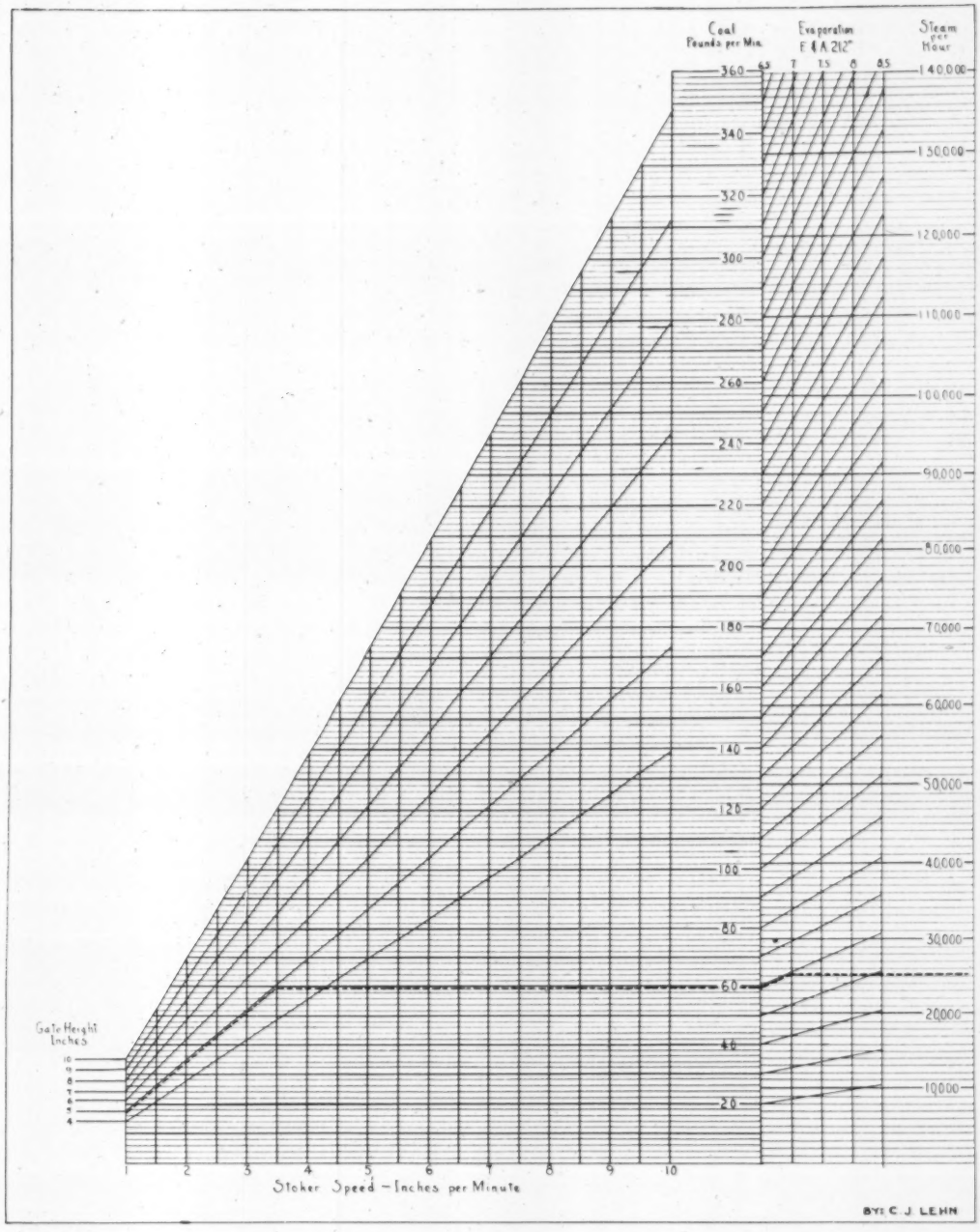


Chart prepared by the author for use with 10 ft wide chain grate stoker and assuming 1 cu ft of coal weighs 50 lb. The dotted line indicates a specific example of the chart's use which is given in the text

How to Air Condition Two Executive Offices

JOSEPH M. AIKMAN, mechanical engineer with A. W. Kerr and Associates, consulting engineers, describes the solution of a problem which is often a puzzler—how to condition individual offices in a non-conditioned building

EARLY IN MAY 1946, we received instructions to have an air conditioning system installed in the offices occupied by Kenneth Parker and Bruce Jeffris at the Parker Pen Co., Janesville, Wis.

The method of air introduction was studied carefully, in order to provide the most economical system. The walls of Mr. Parker's office had been furred out and covered with walnut panels. The ceiling had been furred down about 4 in. and plastered. The walls and ceiling of Mr. Jeffris' office were plastered directly on the masonry.

There was not sufficient space over the ceiling of Mr. Parker's office for the ducts nor was there any location that could be used for vertical ducts from below. Dropping the ceiling of Mr. Jeffris' office would have been quite costly, so the idea of introduction of air through ceiling outlets was discarded.

Mr. Parker's office was heated by means of three concealed cast iron radiators installed under the windows, and Mr. Jeffris' office was heated by one cast iron radiator with metal enclosure under the center window. The building, which is 120 ft by 120 ft with four floors and a basement, is heated by steam with stokers operated intermittently. As steam for the air conditioning system would be required at all times, a connection was made to a small high pressure industrial boiler and the pressure reduced to 5 psi at the air conditioning unit.

To prevent the two offices from becoming cool when the air conditioning unit was shut off, the radiators were provided with diaphragm valves controlled by a thermostat set at 65 deg in each office. These radiators are supplied by the building heating system.

A 5 hp vertical cooling unit was installed in the basement under Mr. Parker's office. It consists of a compressor, cooling coil, filter and two blowers, with separate discharges from the unit. A heating coil and pan humidifier were installed in the discharge duct from each blower and the ducts extended to the inlet grilles in the offices.

Side wall grilles were provided for Mr. Jeffris' office and window stool grilles for Mr. Parker's office. Openings were cut through the concrete floor below the radiators under the end windows in the south wall of Mr. Parker's office for the air supply, and the center window for return air. The grilles near the floor were closed off to prevent the air from blowing out at this point. The stack effect of these radiators provides sufficient heat at night, even with the lower grilles closed.

Parts of the air supply grilles were blanked off with sheet metal, painted black, on the underside of the grilles to avoid blowing the window drapes.

Return air is taken through a new grille in the stool of the center window and through one near the floor. Return air from Mr. Jeffris' office is taken through a grille near the floor and a duct extended through an opening cut through the floor slab. The returns from the two offices are connected together before entering the air conditioning unit. An outdoor air duct is connected to this common return air duct.

The control system provides varying inside conditions when the outside temperature rises above 74 deg. At 74 deg and below outside, the inside dry bulb is held at 74 and the relative humidity at 30 percent. These conditions gradually change as the outside temperature rises until at 102 outside, the inside DB is 84 and the RH is 49 percent. These conditions, while not in accordance with the usual practice, were arrived at by experimenting until the occupants felt comfortable at all times.

Pneumatically operated thermostats and valves control the radiators hereinbefore mentioned to maintain 65 deg when the air conditioning unit is shut off.

A direct acting thermostat and a reverse acting humidistat located in the return air duct from Mr. Parker's office—and a similar thermostat and humidistat on the wall of Mr. Jeffris' office—are readjusted by a thermostat in the outdoor air intake duct.

To secure close control, the sensitivities of the thermostats and humidistats in the return air duct from Mr. Parker's office and on the wall of Mr. Jeffris' office are set at 5 lb variation in the branch lines for 1 deg temperature and 2 percent relative humidity. The thermostat and humidistat for Mr. Parker's office are connected to the right and left sides of a differential cumulator, and the two controls for Mr. Jeffris' office are similarly connected to another cumulator. All instruments are set so that there is 8 lb in the branch lines at control points.

When the pressure on the right side of either cumulator is greater than that on the left side, the branch line pressure increases ½ lb for each 1 lb increase at the cumulator. The branch lines from the

cumulators are connected to mercury switches, either of which will operate the compressor. The fan switch and compressor switch on the unit are turned to the "On" position at all times and the unit is started and stopped by means of a switch located in the closet between the two offices.

The cycle of control for Mr. Parker's office is as follows:

A rise in temperature above the thermostat setting causes it to increase its branch line pressure to its cumulator. As the branch line pressure from the cumulator rises, the respective mercury switch closes and starts the compressor. Should the humidity drop as a result of the compressor operation, the respective reverse acting humidistat increases its branch line pressure and gradually opens the humidifier steam valve. This increase in branch line pressure may be sufficient to stop the compressor as the humidistat is connected to the left side of its cumulator. As a result, the temperature may rise when the compressor has stopped and the thermostat will increase its branch line pressure to the cumulator until it is above the branch line pressure from the humidistat; the cumulator then increases its branch line pressure, closes the mercury switch again, and starts the compressor.

A drop in temperature causes the thermostat to reduce its branch line pressure. This thermostat is also connected to a reverse acting relay which operates a steam valve to the heating coil. When the branch line pressure from this thermostat falls to 6 lb, this valve will gradually open and the temperature of the room will be restored. Should the humidity rise above the setting of the humidistat, the branch line pressure drops and, being connected to the left side of the cumulator, increases the branch line pressure from the cumulator which, through the mercury switch, starts the compressor in order to lower the humidity.

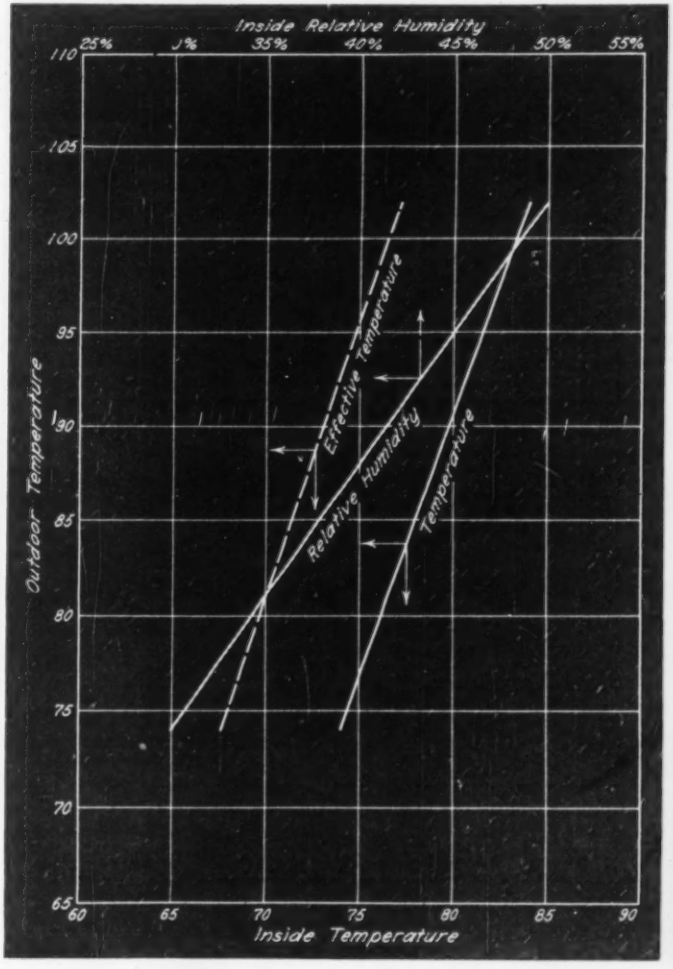
The compressor is thus started either by a rise in temperature or a rise in humidity. The control from Mr. Jeffris' office operates in a similar manner. The mercury switches are connected in multiple so that either one will start the compressor.

The starting of the compressor due to load conditions in Mr. Parker's office would reduce the temperature and humidity in Mr. Jeffris' office. The thermostat in Mr. Jeffris' office would reduce its branch line pressure and, being connected to a reversing relay, cause a steam valve to open gradually and restore the room temperature. The humidistat in Mr. Jerris' office, being reverse acting, would increase its branch line pressure and gradually open a valve to supply steam to the coil in the humidifier pan.

All of the instruments and valves are provided with pressure gages and it is interesting to watch the variation in the pressures while there is hardly a noticeable change in temperature or humidity. The system has been in operation through four summers and three winters and has produced very comfortable conditions throughout the year.

Due to the wide range of the internal load in these offices, steam may be supplied for reheating in the summer and the compressor may operate in the middle of winter. The system was installed by local contractors under the direction of the writer, who personally adjusted the control system.

The control system provides varying inside conditions when the outdoor temperature rises above 74 F. At 102 F outside, the indoor dry bulb is 84 F and the relative humidity 49 percent



SMOG

....the KILLER

Allen D. Brandt Reviews Public Health Service Preliminary Report on Air Pollution at Donora

THE PROCEDURE and findings of the extensive investigation made by the Division of Industrial Hygiene of the U. S. Public Health Service into the various facets of the smog episode in Donora, Pa., and vicinity October 27-31, 1948, are described in detail in a recently published bulletin. This preliminary report, identified as Public Health Bulletin No. 306, represents a large amount of work—the field team alone having been made up of some 25 persons who spent about five months in the Donora area to obtain the information and air samples needed to evaluate the conditions and to arrive at accurate conclusions. The investigation obviously was not made during the smog episode; it was made months later when comparable smog conditions did not exist. However, the same industries operated during the investigation as during the unusual smog episode, so that it is logical to assume that the same air pollutants would be present even if not in the same concentrations.

The investigation was divided into two major categories: the biological studies and the atmospheric studies. The former are not of much professional interest to most readers of this magazine, so only a few of the more important findings will be summarized.

Twenty persons, mostly elderly, died during the smog period and 5910 (42.7 percent of the population) were affected to some degree by the smog. By degree of affection, 2148 persons were mildly affected, 2322 were moderately affected, and 1440 were severely affected by the atmospheric conditions. Some domestic animals became ill and a few died. Long-term studies of mortality and morbidity records indicate that the health of the people in Donora was no different in general from that of the people in nearby towns.

The study of the atmospheric contaminants (both solid and gaseous) included measurements of their concentrations in the air at different locations in Donora and vicinity, and of the amounts discharged by industrial and domestic stacks and even by railroad locomotives and river boats in the area. Studies were made of the materials flow in the three large industries in the area, a steel plant, a rod and wire plant, and a zinc plant. A meteorological analysis of the weather and atmospheric conditions prevailing during the smog was included in the atmospheric studies phase of the investigation.

The concentrations of atmospheric pollutants measured were found to be quite low. The highest sulfur dioxide concentration measured was 0.61 ppm (parts per million by volume) and only 6 percent of the individual measurements were more than 0.30 ppm. The maximum total sulphur was 0.84 ppm with only 14 percent of the values above 0.30 ppm. The maximum particulate matter concentration was 5.32 mg/m³ (milligrams per cubic meter) with only 22 percent of the samples above 1.0 mg/m³. Lead concentrations reached 0.327 mg/m³ with 91 percent below 0.01 mg/m³. The highest zinc concentration was 0.67 mg/m³, 85 percent of the measured concentrations being less than 0.10 mg/m³. Cadmium reached a maximum of 0.0178 mg/m³, only 10 percent being above 0.005 mg/m³.

Many other contaminants were measured but all were so low as to be considered of no significance. Since the concentrations of all atmospheric pollutants were extremely low (at least in the light of present-day knowledge of the toxi-

cology of these materials) it was concluded that no single substance was responsible for the Donora episode. Sulfur dioxide and its oxidation products together with the particulate matter are considered significant contaminants. However, even these cannot be indicted in this instance in the light of existing knowledge.

In the summary of the atmospheric studies, reference is made to the more important contaminants from the different processes or stacks of the nearby industries. Ten specific recommendations are made for reducing the amount of pollutants discharged to the air in this area.

Of Great Interest

This report is of great interest because it represents the first step of this kind in what is predicted to be a vast new field of activity. The rapid passage of ordinances and laws and the "dusting off" of old ones as well as the establishment of governmental air pollution control bodies may well be the handwriting on the wall. Certainly, it behooves engineers everywhere who have responsibility with respect to the discharge of waste products of any kind into the atmosphere to begin taking account.

The investigative procedure described in this report probably has set the pattern for other investigations of this kind. In this connection it was surprising to note that the stack sampling was done by means of the conventional atmospheric sampling equipment commonly employed by industrial hygienists rather than the more or less standard stack sampling equipment that has been used widely by engineers engaged in air or gas cleaning. This point of difference between the two groups should be resolved in the immediate future so that findings by both groups are comparable.

Review of this report is not complete without pointing out that the question, "Why did the 20 people die?" is not answered. Possibly this remains unanswered because the investigation was not made during the smog episode. Much research and study apparently is needed before answers to this and other similar questions are known.

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FIRST ALUMINUM GAS LINE INSTALLED

THE FIRST aluminum gas line to be installed in the nation is an all-welded line extending underground approximately 1.8 miles from the main trunk line of the Alabama-Tennessee Natural Gas Co. to the Listerhill, Ala., plant of Reynolds Metals Co. The line was installed by Lehman Hoge & Scott, Sheffield, Ala.

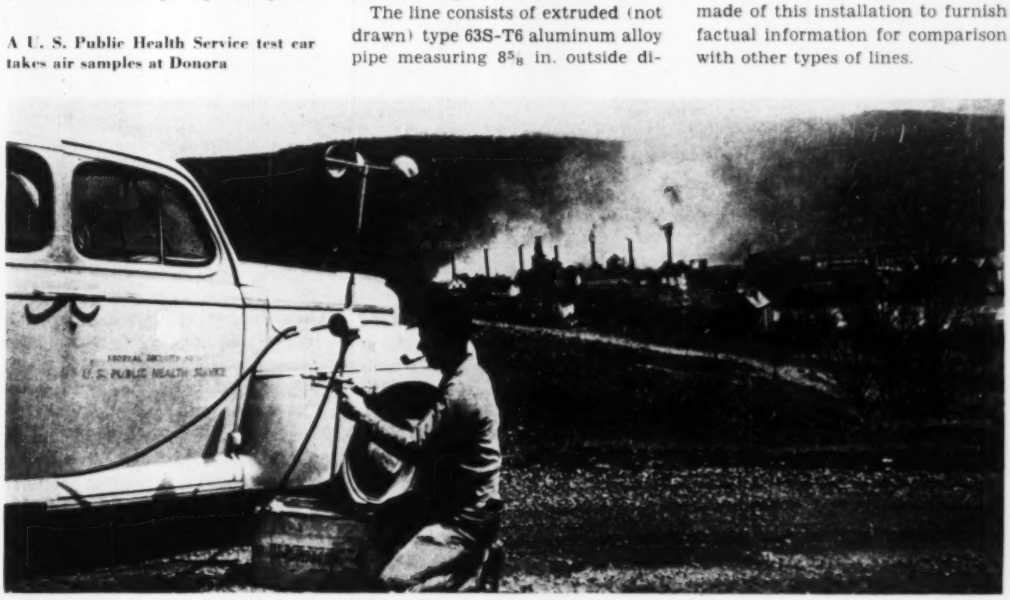
The line consists of extruded (not drawn) type 63S-T6 aluminum alloy pipe measuring $8\frac{5}{8}$ in. outside diameter. Walls are $\frac{1}{4}$ in. thick. The line is designed for a working pressure of 200 lb per sq in.

Pipe arrived on the site in 40 ft lengths and was joined by straight butt welds. Ends were prepared for welding by making a 30 deg bevel at the mill so no end preparation was necessary on the site. The welds were made with two passes, using 3/16 in. diameter 5 percent silicon type aluminum rod. No flux was employed since the heliarc method was used; this method provides a shield of inert gas around the weld zone, protecting the weld and surrounding metal from the action of the atmosphere.

After welding, the entire length of the line, including joints, was wrapped by applying a pipe wrap, except for a single 40 ft section which was left unwrapped to determine if wrapping is necessary. This section was bypassed with another length of pipe which will be wrapped. Valves disconnect the unwrapped section from the line and allow the gas to flow through the bypass.

It is planned to dig up the unwrapped section of the line at six-month intervals for examination. Some experimental work already completed has indicated that the wrapping of the aluminum pipe may not be necessary.

A careful cost analysis is to be made of this installation to furnish factual information for comparison with other types of lines.



A U. S. Public Health Service test car takes air samples at Donora

While New York City's water shortage has dominated the headlines in recent weeks, the problem is of national scope

Water, Water Everywhere . . . But Not Enough

AIR CONDITIONING, as a large user of water for condensing purposes, is right in the middle of current water conservation efforts. Fortunately, well-proved water conservation equipment is available, and its use on a specific installation depends on the economics of the particular case and local regulations affecting water supply and disposal. A reader in the Southwest, in a city confronted with the problem of water conservation, asks here what other cities and areas are doing

WATER SHORTAGES in New York City—which last month ruled that all new air conditioning installations over three tons in capacity must re-use condensing water in order to limit water consumption to 5 percent of that normally used without conservation equipment—have been very much in the news in recent weeks. The same problem, however, is national in scope and arises with increasing severity in many cities and areas throughout the country.

For example, a reader in the Southwest wrote HPAC's editors last month as follows:

"As in many other towns, we are faced with the problem of water conservation.

"The problem does not seem to be in the larger tonnage refrigeration jobs (15, 20, and above) as much as in the 3 and 5 ton water cooled, self-contained jobs. There is talk here of instituting an ordinance which will make it mandatory to equip 3 hp and over compressors with either a cooling tower or evaporative condenser. If such an ordinance were passed, there would be a considerable increase in the price of such installations, and consequently volume would be down.

"Do you have any information on other places that have given consideration to this problem, or have taken action on it?

"There is also interest in equipping evaporative coolers with circulating pumps to eliminate the

overflow of water on the streets through roof drains, etc. This is not as important a problem as the refrigeration problem, but if you have any information on it, we would be glad to have it."

In commenting on these questions at the invitation of the editors, Arthur J. Hess, of Hess, Greiner & Polland, Inc., Los Angeles—who served as chairman of a round-table session on water re-use at the recent annual meeting of the American Society of Refrigerating Engineers—writes as follows:

"The problem of water conservation is becoming more or less general throughout the United States, with many of our major cities and some of our states enacting conservation legislation with reference to refrigeration and air conditioning.

"Some of the communities where legislation has been passed are New York City; Miami; Richmond; Pasadena; Wichita; Champaign, Ill.; and the states of Virginia and Indiana.

"One of the arguments of the American Water Works Association concerning such regulation seems to answer the questions set up in the request from your reader; namely, that the increased cost of refrigeration with water conservation devices will limit the installation of many jobs. The AWWA takes the stand that much of the cost of supplying water to air conditioning systems is not paid for by the use of the system for two reasons. One is that much of the original investment in water systems, since they are almost all municipally owned, are paid for out of taxes and do not show up on the water bill. Also, air conditioning systems (being a very inconsistent load, considering the whole year) do not pay for the increased cost of mains necessary to supply this greatly increasing load.

"With reference to the type of regulation throughout the country, most cities seem to be stabilizing at about 3 hp; that is, systems in excess of 3 hp will require water conservation devices. However, many areas are setting their regulation up on a gallonage per minute per ton of refrigeration, and this seems to be stabilizing at around the point of 0.05 gpm per ton. This figure will allow for the necessary evaporation to carry off the approximately 12,000 Btu per ton plus the heat of the compressor and will allow some (roughly 50 percent) for blowoff or bleed. A water regulation establishing such a figure of course requires use of a cooling tower or evaporative condenser.

"It is admitted that there will be a considerable increase in the price of air conditioning installations; but from the facts which are now becoming available, apparently this will be a necessary added burden on the air conditioning industry since other uses of water are more important than is air conditioning—especially when we can limit the amount of water used in air conditioning by the use of conservation devices.

"It should be noted, in connection with water conservation, that there is getting to be considerable pressure on the refrigeration industry to use in the smaller jobs (that is, 2 hp and smaller) air cooled condensers.

"With reference to the question concerning evaporative coolers, many communities now require the use of circulating pumps in evaporative coolers; however, whenever such pumps are used, there should always be some bleed or blowdown allowed to run off to the waste disposal system. This is because the reconcentration of the salts in the water without the blowdown is sufficiently great to ruin completely the pad used for evaporation by practically making it into a mass of concrete. Suitable pumps are now available for this work. In the past, most of the pumps that have been available have been a continuous source of trouble, though it is my belief that a part of this trouble has been due to failure to maintain the quality of water so that it can be easily circulated."

"QUOTE"

"THE ARMY is governed by the Constitution of the United States, the Articles of War, general and special orders, and the customs of the service—which take precedence in inverse order."—Roger Sherman Hoar, in a recent talk on patent law for engineers.

ADVANTAGES OF AIR CONDITIONING

A QUESTION signed "M.A.," published in the November HPAC on pages 102 and 103, interested me. It referred to the possible health and efficiency values of installing air conditioning in a three story office building with a full basement which will probably be developed for working space at a later date. Some doubt had been expressed regarding the value of air conditioning such a building, and "M.A." asked for data on the overall efficiency and health conditions of people working in an air conditioned building.

It is my suggestion that a good air conditioning system could be installed in only part of the building; say, for the second and third floors only. In this way, the conditioned space could be compared with non-conditioned space and any doubt as to its advantages could be dispelled.

The system could be arranged so that it consisted of two units, with only one unit installed until it proved itself; then the second unit could be installed later. With proper planning this could be achieved with very little interruption to work routine. The two units should be large enough to allow for the possible expansion in the basement.

For All Seasons

Air conditioning is not for summer use only but for all seasons. A good air conditioning system should regulate air temperature, humidity, cleanliness and air motion. By providing a triethylene glycol vapor unit in the air conditioning system, the health of the employees can be improved.

When we condition air, we are adjusting the air in an enclosure to make our bodies as comfortable as practicable, under healthful conditions.

There have been numerous articles published in HPAC on the advantages of air conditioning various kinds of plants and buildings which "M.A." would find valuable in arriving at a decision.—SHELDON R. HIGGINS, mechanical engineer.

[Editor's Note—Since publication of this question in our November issue, we have been advised that it has been decided to proceed with the design and installation of an air conditioning system for this three story building.]

How to S-p-a-c-e

PIPE SUPPORTS

THEODORE E. BRIDGE, a mechanical engineer with the University of Chicago in connection with a project under construction for the Argonne National Laboratory, acquired a wide experience in the design of power and of process piping during 15 years with E. I. du Pont de Nemours & Co.; he has also had experience in the field of very high pressures. In his article he presents a rational method for determining the spacing of pipe supports. The data are of particular value in those instances where it is desired to place the supports as far apart as possible. Very little published information on the matter is available elsewhere

A RATIONAL method for determining the spacing of pipe supports has been given in the October, November, and December issues. In this concluding article, four sample problems are worked out in detail to show how the method is used. The necessary equations, chart, tables, and drawings are repeated this month so that it will be unnecessary to refer back to the earlier articles in order to follow the examples. The figures have been numbered A,B,C,D,E, and F. The first four were originally numbered Figs. 6, 1, 8, and 9, respectively, and Fig. F was originally identified as Fig. 10.

Sample Problem No. 1, in which the Thermal Expansion Stress and the Pressure Stresses are Negligible—A piping system is laid out as shown in Fig. A. The pipe is a low pressure steam line, 8 in., schedule 40. Inside diameter D' is 7.981. Outside diameter D'' is 8.625. Pipe wall thickness t is 0.322. Mean pipe diameter, $D = D' + t$, is 8.303. Length between fixed supports, L, is 50 ft. Length between free supports, L', is 41 ft according to the scale in Fig. B. The piping is to be covered with $1\frac{1}{2}$ in. of 85 percent magnesia insulation, $t'' = 1.5$. A wind load of 30 lb per sq ft will be assumed. W' (the wind loading on the pipe) $= 30\ (D'' + 2t'') / 12 = 30 \times 11.625 / 12 = 29$ lb per ft. It will be assumed that the pressure stresses and the thermal expansion stresses are so low as to be negligible.

The weights of the piping are obtained from Table 1. Empty pipe; $W = 28.5$ lb per ft. Any steam line might, in an emergency, become flooded with water; $Wc = 21.6$. The weight of the insulation; $Wi = 5.3$. The total weight of the pipe is $W'' = W + Wc + Wi^f = 55.4$.

Line 1-1 is drawn on the chart in Fig. B through $D = 8.303$ and $L = 50$. This line indicates that slope $Z = 0.38$ percent, slope $Z' = 1.06$ percent, and $S = 4000$ psi. These values for slope must be increased by the ratio of weights to obtain actual design values. From Equation 13, $Z'' = Z(1 + Wi/W) = 0.38\ (1 + 5.3/28.5) = 0.45$ percent. This means that, if it is desired to completely drain the piping system, it should be given a pitch of 2.7 in. in the 50 ft span. Similarly, from Equation 22, $Z'' = Z'\ (1 + Wi/W) = 1.06\ (1 + 5.3/28.5) = 1.26$ percent. This means that the end spans should be given pitch equal to 6.2 in. in the 41 ft between supports if it is desired to completely drain the piping.

It has been the practice of the author to install steam pipes level when they can be drained in the direction of flow, provided the calculated slope is less than 0.40 percent.

Since the thermal expansion stresses are assumed to be zero, $Sv = S''$ and $Sh = Sw$.

The chart values for stress must also be corrected by the ratio of weights to obtain actual design values. From Equation 62, $Sv = S'' = S\,W''/W = 4000 \times 55.4 / 28.5 = 7800$. From Equation 63, $Sh = Sw = S\,W'/W = 4000 \times 29 / 28.5 = 4070$ psi. From Equation 67, $Sb = \sqrt{Sv^2 + Sh^2} = 8800$ psi.

This calculated stress of 8800 psi is a very low stress for any of the standard piping materials at normal low pressure steam temperatures. ASTM A53, butt welded steel pipe, is limited by the Code for Pressure Piping to a fiber stress of 6500 psi at 250 F. This material would, nevertheless, be satisfactory for the bending stress of 8800 psi calculated above, because the bending stress does not come on the weld. The code limitation applies to the hoop tension, which stress places the weld in tension.

Sample Problem No. 2, in which

SYMBOLS

c = the corrosion allowance, in. (usually taken as 0.065).

D = mean diameter of pipe, in. $D = D' + t$.

D' = inside diameter of pipe, in.

D'' = outside diameter of pipe, in.

K = ratio of outside to effective inside diameter. $K = D''/(D'' - 2t' + 2c)$.

L = distance between fixed supports, ft.

L' = distance between free supports, ft.

P = the design pressure of the fluid in the pipe, psi.

S = bending stress, due to its own weight, in a bare empty steel pipe, psi.

S'' = bending stress, due to the total weight of pipe, contents, and insulation, psi.

Sa = axial stress caused by pressure in the pipe, psi.

Sb = resultant bending stress in the pipe, psi. $Sb = \sqrt{Sv^2 + Sh^2}$

Se = the equivalent stress obtained by combining all of the other stresses in the pipe according to the maximum shear theory (note that this is sometimes called the double shear stress), psi.

Sh = the horizontal component of the bending stress, psi.

Sp = the hoop tension in the pipe wall caused by pressure in the pipe, psi.

Sr = the radial stress in the pipe wall caused by pressure in the pipe, psi.

St = the bending stress caused by thermal expansion of the pipe, psi.

Sv = the vertical component of the bending stress in the pipe, psi.

Sw = bending stress due to wind load, psi.

T = the shear stress caused by twisting of the pipe due to thermal expansion, psi.

t = the nominal thickness of the pipe wall, in.

t' = the minimum thickness of the pipe wall, in.

t'' = the thickness of the pipe covering, in.

V = the vertical shear loading on the pipe, lb.

W = the weight of bare empty steel pipe, lb per ft.

W' = the wind loading on the pipe, lb per ft.

W'' = the total weight of the piping as installed including contents and covering, lb per ft. $W'' = W + We + Wi$.

We = the weight of the fluid in the pipe, lb per ft.

Wi = the weight of the pipe covering on the pipe, lb per ft.

Z = the slope required to drain a bare empty steel pipe with fixed supports, percent. This is taken as double the maximum slope calculated for the pipe in order to allow for possible misalignment during erection.

Z' = the slope required to drain a bare empty steel pipe with free supports, percent.

Z'' = the actual slope required to drain the pipe as installed with the weight of the covering included, percent.

the Pipe Installed Over the Track at a Railroad Crossing Must Be Considered as a Freely Supported Beam Because of Flattening Effect at the Elbows. By Eliminating the Cold Springing, the Thermal Expansion Stress Is Made to Subtract from the Bending Stress—Assume that a 150 psi, 400 F steam line is installed as shown in Fig. C and that the distance between the supports at the track crossing is 50 ft. It may be assumed that the adjacent spans are considerably shorter, and that the thermal expansion of the pipe, when it is in service, introduces a negative bending stress in the main span in a vertical plane, $St = -5000$ psi. It will be assumed that no cold springing is applied, so that the thermal expansion stress will never add on to the bending stress. Assume 10 in., schedule 40 pipe; $D' = 10.02$, $D'' = 10.75$, $t = 0.365$; $D = 10.02 + 0.365 = 10.385$; $L' = 50$ ft.

Inasmuch as the main span over the tracks is the high point in the system, it may be assumed that it will never be full of water while the pipe is operating under steam pressure. It may be necessary to block the span during hydrostatic test if it is desired not to overstress the pipe during the test. A moderate amount of overstress is, however, permissible during the hydrostatic test, as the main purpose of the test is to show up weaknesses by overstressing weak spots. According to Table 1, W is 40.5. $We = 0$. The insulation thickness, t'', is 2 in., so $Wi = 9.5$ (from Table 1). The total weight, W'', is 50 lb per ft.

If a wind load of 30 lb per sq ft is

Table 1—Weights per foot of pipe in pounds

Diameter		1	1¼	1½	2	2½	3	4	6
Bare empty pipe									
Schedule	40	1.68	2.27	2.72	3.65	5.79	7.57	10.79	18.97
	80	2.17	3.00	3.63	5.02	7.66	10.25	14.98	28.57
	160	2.85	3.76	4.86	7.45	10.01	14.30	22.60	45.30
	XX	3.66	5.21	6.41	9.03	13.69	18.58	27.54	53.16
Water in pipe									
Schedule	40	.374	.647	.882	1.45	2.07	3.20	5.51	12.51
	80	.311	.555	.765	1.28	1.83	2.86	4.98	11.29
	160	.226	.458	.608	.971	1.53	2.35	4.02	9.16
	XX	.122	.273	.412	.769	1.07	1.80	3.38	8.14
Magnesia covering									
360 F	Std. th.	.65	.80	.85	1.25	1.35	1.55	2.10	2.90
440	1½ in.	1.45	1.60	1.75	2.05	2.30	2.65	3.15	4.15
525	2 in.	2.25	2.45	2.65	3.15	3.40	3.95	4.75	6.40
800	(Combi-	3.70	4.10	4.20	5.80	6.60	8.30	9.80	14.90
1000	nation)	3.70	4.10	4.20	7.40	8.50	10.70	12.20	24.20

Diameter		8	10	12	14	16	18	20	24
Bare empty pipe									
Schedule	10				37	42	47	53	63
	20	22.4	28.0	33.4	46	52	59	79	95
	30	24.7	34.2	43.8	55	63	82	105	141
	40	28.5	40.5	53.6	63	83	105	123	171
	60	35.7	54.7	73.2	85	108	133	167	240
	80	43.4	64.4	88.6	107	137	171	269	297
	120	60.7	89.2	125.5	147	193	239	297	416
	160	74.7	116.0	161.0	190	241	304	374	536
Water in pipe									
Schedule	10				62	82	105	130	188
	20	22.5	35.9	51.3	61	80	102	126	184
	30	22.2	35.0	49.7	60	79	100	123	178
	40	21.6	34.1	48.5	58	76	97	120	174
	60	20.8	32.3	46.0	56	73	93	115	166
	80	19.8	31.1	44.0	53	70	89	109	158
	120	17.6	27.9	39.3	48	63	80	98	143
	160	15.8	24.6	34.9	43	56	72	89	128
Magnesia covering									
260 F	1¼ in. th.	4.1	5.2						
360	1½ in. th.	5.3	6.6	9.6	10	12	13	14	17
440	2 in. th.	7.7	9.5	12.5	13	15	16	18	22
525	2½	10.3	12.3	15.5	17	19	21	23	27
600	3	12.5	14.2	18.8	20	23	25	27	32
800	(Combi-	19.6	23.5	31.6	33	37	40	45	52
1000	nation)	26.7	33.3	36.5	39	44	48	52	61

Table 2—Factors with which to correct the values obtained from the alignment chart in Fig. 1 for use with materials other than steel

	Correction factors	
	Slope	Stress
Aluminum	0.97	0.35
Brass	2.45	1.07
Copper	2.06	1.14
Chemical lead	27.6	1.43
Cast iron	2.21	0.916
Steel	1.00	1.00
Stainless steel	1.00	1.00
Monel metal	1.25	1.125
Nickel	1.09	1.13

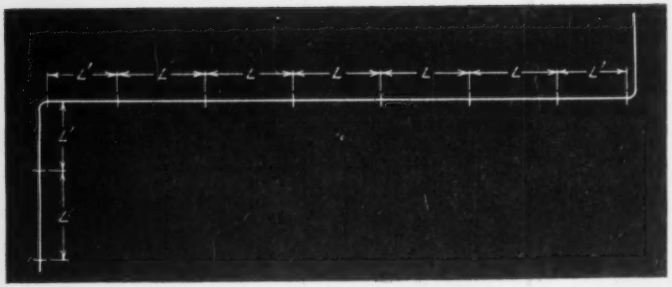
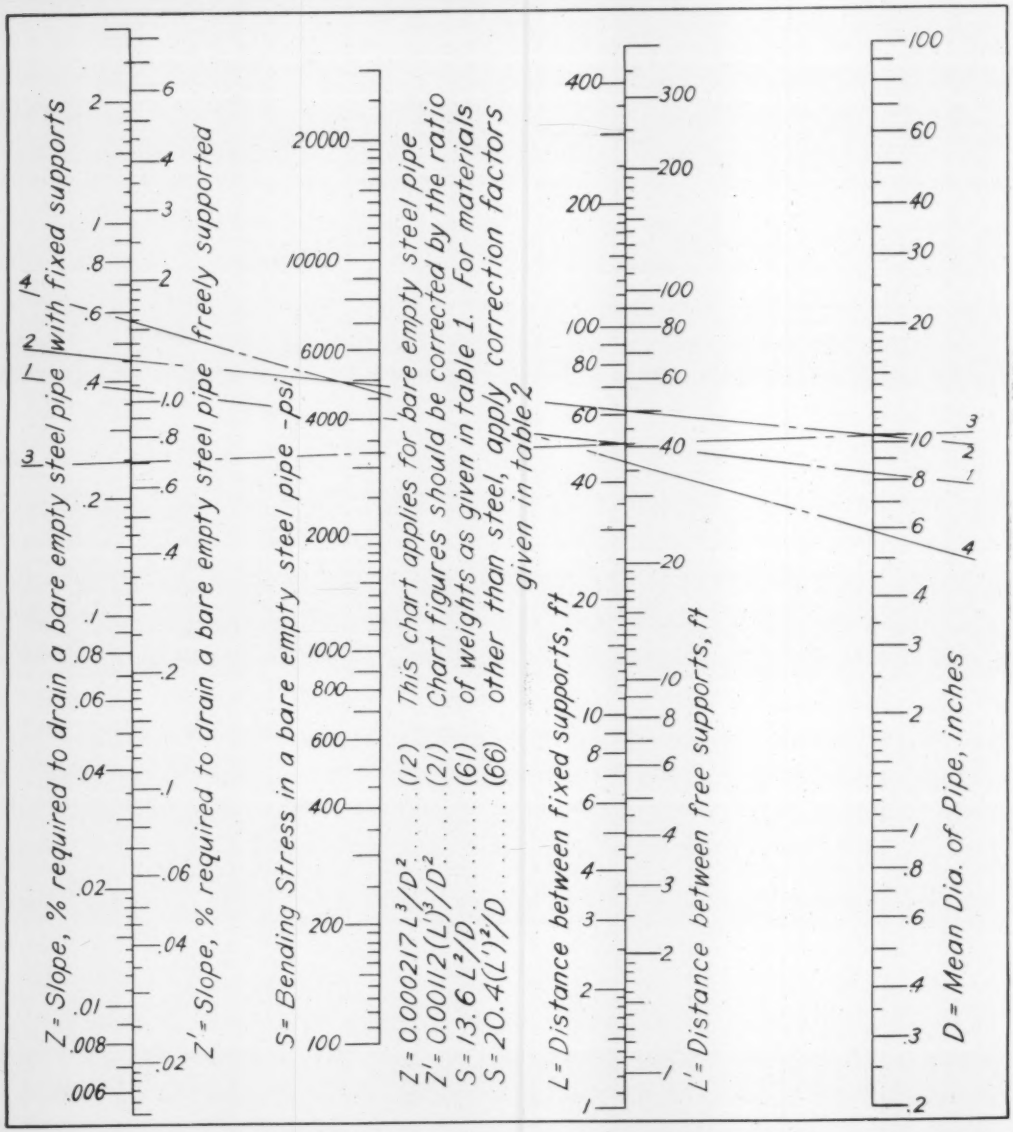


Fig. A *(left)*—An actual piping system in which the end spans are considered freely supported and the other spans are considered fixed

Fig. B *(bottom)*—Chart used to determine the maximum spacing of pipe supports


Z = Slope, % required to drain a bare empty steel pipe with fixed supports
Z' = Slope, % required to drain a bare empty steel pipe freely supported
S = Bending Stress in a bare empty steel pipe - psi
Z = 0.000217 L³/D² ..... (12)
Z' = 0.00112 (L')³/D² ..... (21)
S = 13.6 L²/D ..... (61)
S = 20.4 (L')²/D ..... (66)
This chart applies for bare empty steel pipe
Chart figures should be corrected by the ratio
of weights as given in table 1. For materials
other than steel, apply correction factors
given in table 2
L = Distance between fixed supports, ft
L' = Distance between free supports, ft
D = Mean Dia. of Pipe, inches

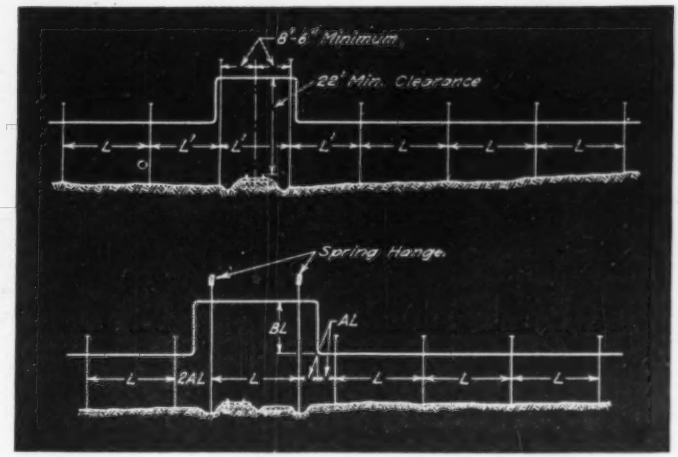


Fig. C *(upper left)*—Normal clearances at a railroad crossing, showing that the spans adjacent to the elbows in the vertical plane are considered to be freely supported due to the flattening effect introduced by the elbows

Fig. D *(lower left)*—How all spans at a railroad crossing may be considered fixed, if the piping is made to overhang the supports by a calculated amount which will introduce negative bending moment at the support to make it equivalent to a fixed span

Fig. E *(bottom)*—Weight of cork pipe covering, assuming density of cork as 14 lb per cu ft

assumed, $W' = 30(D'' + 2t'')/12 = 30 \times 14.75 / 12 = 37$.

Line *2-2* is drawn on Fig. B through $L' = 50$ and $D = 10.385$. This line indicates that the slope $Z' = 1.27$ and the stress $S = 4800$ psi. The slope is corrected by the ratio of weights as indicated in Equation 22, as follows:

$Z'' = Z'(1 + Wi/W) = 1.27(1 + 9.5 / 40.5) = 1.57$ percent. From Equation 62, $S'' = S\,W''/W = 4800 \times 50 / 40.5 = 5920$ psi. Also, from Equation 63, $Sw = S\,W'/W = 4800 \times 37 / 40.5 = 4400$ psi.

It is stated in the data given that the thermal expansion stress will act in the vertical plane, and will subtract from the bending stress S''. Consider first conditions at the end of the span where the wind load and dead weight bending stresses will be zero ($Sw = 0$ and $S'' = 0$). Therefore, $Sb = St = -5000$ psi.

Next, consider conditions at the middle of the span where the bending stress due to thermal expansion St will deduct from the bending stress caused by the dead weight of the pipe:

$Sv = S'' - St = 5920 - 5000 = 920$ psi

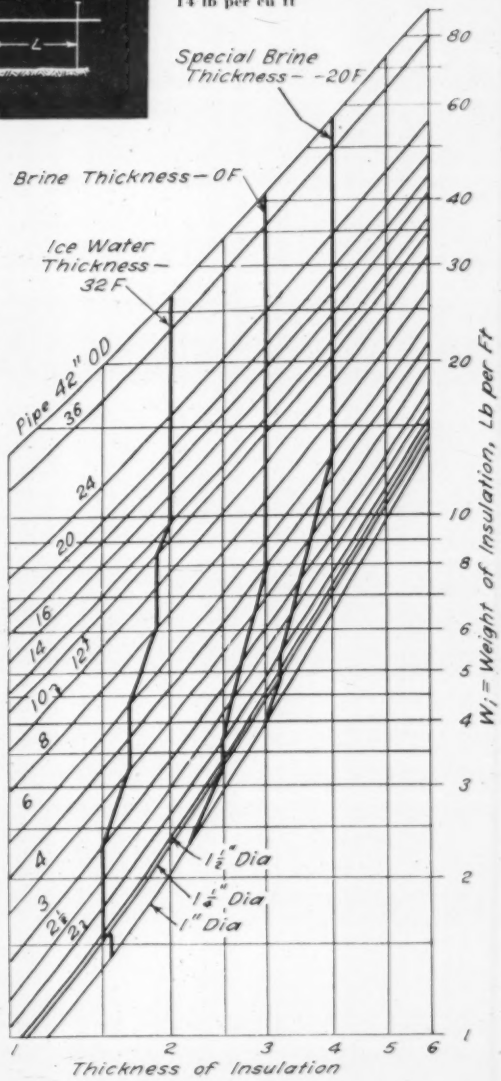
$Sh = Sw = 4400$ psi

$Sb = \sqrt{Sv^2 + Sh^2} = 4509$ psi

From the above, it is seen that the bending stress is a maximum at the end of the span, where $Sb = -5000$ psi. From Equation 69, $Sp = [P\,D''/2(t'-c)] - 0.4P$; where $c = 0.065$ and $t' = 0.875\,t = 0.319$ (the minimum wall thickness of ASTM A53 seamless pipe. Therefore $Sp = [150 \times 10.75/2\ (0.319 - 0.065)] - 0.4 \times 150 = 3180 - 60 = 3120$ psi.

From Equation 68, $Sa = P\,D'/4t = 150 \times 10.02 / 4 \times 0.365 = 1025$ psi. From Equation 71, $Sr = P = 150$. The shear stress T is given as zero. Therefore, from Equation 74, $Se = Sa - Sb - Sp = 1025 - 5000 - 3120 = -7095$ psi. Also, from Equation 75, $Se' = Sr + Sa + Sb = 150 + 1025 + 5000 = 6175$ psi. Finally, from Equation 76, $Se'' = Sr + Sp = 150 + 3120 = 3270$ psi.

From Equation 74 above, it is indicated that the maximum combined stress occurs when the pipe is under pressure at either end of the main span. The above calculated stresses are permissible in ASTM A53 Grade A pipe.



The span across the tracks should be given a pitch of 1.57 percent, or $0.0157 \times 12 \times 50 = 9.5$ in. to be sure that condensate will not be pocketed in the middle of the span.

Sample Problem No. 3, Illustrating How the Effect of a Fixed Span May Be Produced at a Track Crossing by Making the Piping Overhang the Supports By a Calculated Amount—Assume that a 10 in., schedule 40 brine line (specific gravity 1.2) is to be carried across railroad tracks with a pole spacing of 50 ft. The clearance over the tracks is 22 ft and the balance of the line will be carried at an elevation 12 ft above the tracks as shown in Fig. D. The constant B is therefore $(22 - 12)/50 = 0.20$.

In order to produce the effect of a fixed span, the constant A will be determined from Equation 58 as follows:

$$A = (-B + \sqrt{B^2 + 0.667})/2 = (-0.2 + \sqrt{0.04 + 0.667})/2$$

Therefore, $A = (-0.2 + 0.84)/2 = 0.32$, and $AL = 16$ ft.

As in sample problem No. 2, $D' = 10.02$, $D'' = 10.75$ and $t = 0.365$; also, $t' = 0.875\ t = 0.319$. $D = 10.385$.

The line *3-3* drawn on the chart in Fig. B through $D = 10.385$ and $L = 50$ indicates that $Z = 0.25$ percent and $S = 3250$ psi.

Assume that special brine thickness cork is to be used ($t'' - 4$ in.) From Fig. E, $Wi = 18$. From Table 1, $W = 40.5$ and $Wc = 1.2 \times 34.1 = 41$. Therefore, $W'' = W + Wi + Wc = 99.5$. Assuming a 30 lb per sq ft wind loading, $W' = 30\ (D'' + 2t')/12$

$$W' = 30 \times 18.75/12 = 47 \text{ lb per ft}$$
$$Z'' = Z\ (1 + Wi/W) = 0.25 \times (1 + 18/40.5) = 0.36 \text{ percent}$$
$$S'' = S\ W''/W = 3250 \times 99.5/40.5 = 8000 \text{ psi}$$
$$Sw = S\ W'/W = 3250 \times 47/40.5 = 3770 \text{ psi}$$

It may be assumed that the thermal expansion stresses St have been calculated with results as follows: Vertical component of St is 500 psi, $Sv = S'' + 500 = 8500$ psi. Horizontal component of St is 1000 psi, $Sh = Sw + 1000 = 4770$ psi.

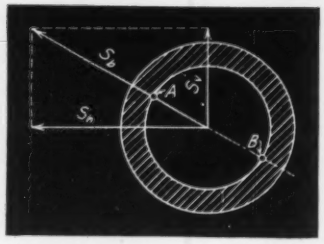


Fig. F—Section through pipe at point of maximum bending moment. Two points of maximum stress are indicated, *A* and *B*. *Sh* is the horizontal component of the bending stress caused by wind load and thermal expansion. *Sv* is the vertical component of the bending stress, and *Sb* is the resultant bending stress in the pipe

The twisting component of the thermal expansion stress is $T = 1200$ psi shear stress. From Equation 67,

$$Sb = \sqrt{Sv^2 + Sh^2} = 1000\sqrt{72.0 + 22.8} = 9750 \text{ psi}$$

The design pressure of the fluid in the pipe is given as $P = 75$ psi.

From Equation 69, $Sp = [P\ D''/2\ (t' - c)] - 0.4P = [75 \times 10.75/2\ (0.319 - 0.065)] - (0.4 \times 75)$ and $Sp = 1580 - 30 = 1550$ psi.

From Equation 68, $Sa = P\ D'/4t = 75 \times 10.02/(4 \times 0.365) = 514$ psi.

From Equation 71, $Sr = P = 75$ psi.

From Equation 72, $Se = \pm \sqrt{(Sa + Sb - Sp)^2 + 4\ T^2}$.

From Equation 73, $Se' = (2Sr + Sa + Sb \pm Se + Sp)/2$

Note that Sb is taken as plus for point B in Fig. F and minus for point A.

Equation 72 is first solved in tabular form as shown in Table 3 for point A and point B in Fig. F.

There are six possible values for Se as calculated in Table 3. The largest of these is indicated by the asterisk (*). The columns on the left show the stress for point B in Fig. F, whereas the columns on the right show the stress for point A. Any one of the six values calculated might, on occasion, be the largest but it is usually not necessary to figure all stresses in detail. The calculated stress of 11,050 psi is not excessive for ASTM A53 seamless grade A pipe.

Sample Problem No. 4, Illustrating How the Various Stresses Are Combined in a Pipe Under a High Operating Pressure—It is desired to calculate the combined equivalent stress Se in a bare, 6 in. schedule 160 steel pipe operating under a hydraulic pressure of $P = 2000$ psi. The distance between fixed supports is $L = 45$ ft, $D' = 5.189$, $D'' = 6.625$, $t = 0.718$ and $D = 5.907$. Also, $t' = 0.875 \times t = 0.63$.

From Table 1, $W = 45.30$, $Wc = 9.16$ and $W'' = 54.46$. Assuming a 30 lb per ft wind load, $W' = 30 \times 6.625/12 = 16.6$.

Line *4-4* is drawn on the chart in Fig. B through $D = 5.907$ and $L = 45$. This line indicated that $Z = 0.57$ percent. But $Wi = 0$, so $Z'' = 0.57$ percent. It also indicates that $S = 4600$ psi. From Equation 62, $S'' = S\ W''/W = 4600 \times 54.46/45.3 = 5520$. From Equation 63, $Sw = S\ W'/W = 4600 \times 16.6/45.3 = 1680$.

It will be assumed that the thermal expansion stress acts in a horizontal plane, $St = 5000$. Therefore, $Sh = Sw + St$. $Sh = 1680 + 5000 = 6680$; also, $Sv = S'' = 5520$. From Equation 67

$$Sb = \sqrt{Sv^2 + Sh^2} = 8680 \text{ psi}$$

From Equation 68, $Sa = P\ D'/4t = 2000 \times 5.189/(4 \times 0.718) = 3600$ psi.

From Equation 71, $Sr = P = 2000$ psi, and from Equation 70, $Sp = P\ (K^2 + 1)/(K^2 - 1)$. Letting $c = 0$, $K = D''/(D'' - 2t') = 6.625/(6.625 - 1.26) = 1.24$ and $K^2 = 1.54$. So $Sp = 2000 \times 2.54/0.54 = 9400$ psi.

From Equation 74, $Se = Sa - Sb - Sp = 3600 - 8680 - 9400 = -14{,}480$ psi.

From Equation 75, $Se' = Sr + Sa + Sb = 2000 + 3600 + 8680 = +14{,}280$ psi.

From Equation 76, $Se'' = Sr + Sp = 2000 + 9400 = 11{,}400$ psi.

The maximum stress calculated by Equation 74 is permissible in ASTM A106 grade B pipe.

[In the first line of the second column of p.92 in the December issue, *Sp* should have read *Sb*.]

Table 3

		Point B	*Point A*	
Solving Equation 72.				
	Sa =	+ 514	+ 514	
	Sb =	+ 9750	— 9750	
	$-Sp$ =	— 1550	— 1550	
	Total above	+ 8714	— 10786	
	Square	76.000.000	116.000.000	
	$4\ T^2$ =	5.700.000	5.700.000	
	Total	81.700.000	121.700.000	
Solving Equation 73.				
Square root =	Se,	—9050	+11050*	—11050*
	Sb =	+ 9750	+ 9750	+ 9750
	$2\ Sr$ =	+ 150	+ 150	+ 150
	Sa =	+ 514	+ 514	+ 514
	Sp =	+ 1550	+ 1550	+ 1550
Total	=	21014	small	—18586
Divide by 2.	Se' =	10.507		9.293

QUESTION OF THE MONTH

Does Antifreeze in a Heating System Affect Heat Transfer?

WHAT'S THE effect on pipe friction and heat transfer when an antifreeze compound is used in a heating system for snow melting, panel heating, or other service? This question was asked of HPAC by a heating and piping contractor who was having trouble on such a job.

The following information has been prepared, in answer to this question from a reader, by P. B. Gordon, of Wolff & Munier, Inc., engineers and contractors, who has had a wide experience in radiant panel heating and snow melting work.

I BELIEVE THAT thought should be given to developing some simple charts or tables to permit designers to correct heat transfer values and pipe friction values for the circulation of warm water when used in snow melting systems with antifreeze solution added. I know of no ready table or chart that will permit this for the usual antifreeze compounds. The conventional thing to do is to correct water pipe friction data by the necessary conversion factors to account for the change in viscosity, etc. This can readily be done by use of the tables and charts in the book, Cameron Hydraulic Data, published by Ingersoll-Rand Co., or the tentative standards of the Hydraulic Institute, pipe friction data, published in 1948.

In an article in the April 1938 HPAC, by R. C. Doremus, there was a series of multiplier values to correct pipe friction values for refrigerent brines. Something similar should be prepared for the more usual glycol solutions used in snow melting and panel heating work.

The change in viscosity would increase the pipe friction and this usually amounts to an increase of about 40 to 50 percent in total circulating head for 40-50 percent ethylene glycol and water solutions over the friction developed when circulating an equivalent quantity of water without antifreeze at the same temperature. Failure to correct for this increase in circulating head would result in lack of pumping capacity.

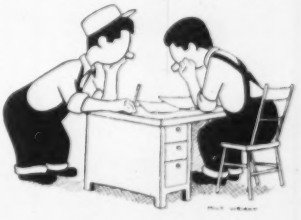
Concerning the effect of antifreeze on the heat transfer rates, this problem breaks down into two phases—that of the design of the panel and the design of the heat exchanger. The effect on panel design is not pertinent as the heat transfer rate within the pipe is not the limiting factor that controls the overall heat transfer from the circulating fluid to the room to be heated or to the snow to be melted. Considering snow melting work with overall heat transfer rates in the order of 100 to 150 Btu per hr per sq ft of sidewalk area, this reduction in heat transfer rate due to change of the inside film coefficients is not important. The bottleneck in the overall transfer of heat is still the conduction rate from the pipe to the panel surface and from the panel surface to either the room or the snow.

However, the effect of snow melting antifreeze solutions on the heat transfer rates of the heat exchanger is important. The manufacturer of the heat exchanger should be consulted to obtain the actual performance data. This should be determined in terms of the gpm of solution to be heated, the type and percentage of antifreeze to be used, the temperature rise through the heater, etc.

Roughly, the usual convertor would be doubled in heat transfer surface as compared with its performance when using water. The overall heat transfer rates for a solution of water and ethylene glycol fall off rather rapidly from the water rates. For example, a 40 percent solution of ethylene glycol and water, to be heated with the solution flowing through $\frac{3}{4}$ in. steel tubes at, say, 3 fps, might end up with an overall heat transfer rate of 285 Btu per hr per sq ft per 1 F mean effective difference for an average circulating temperature of 120 F instead of a comparable rate of about 500 Btu per hr per sq ft per 1 F MED when heating water. This would be with steam at 5 lb gage in the shell.

Though the transfer rate on the hot side of the tubes does not change, the transfer rate on the inside of the tubes is materially affected by the change in specific gravity, viscosity, specific heat, etc., of the antifreeze, which changes the inside film coefficient. For the usual heat exchanger using steam for heating, the bottleneck in overall heat transfer is the limiting value of the film coefficient in the inside of the tubes.

While the heat exchanger manufacturer takes all this into consideration if he is consulted, there is always the danger of the indiscriminate use of standard factory-packaged heat exchangers such as submerged hot water coils, etc., which are sold to heat definite quantities of water through given temperature ranges. If unwisely used to heat a solution of water and antifreeze, the result may be that the heat exchanger would be shy as much as 50 percent in heat transfer surface.



PRACTICAL PIPING

PROBLEMS By Robert C. Soronen

ROBERT C. SORONEN, engineer specializing in design and supervision of heating, ventilating, air conditioning, industrial exhaust systems, process piping systems, and drying systems, gives some practical suggestions here—based on his wide experience—on flash tanks and blowoff tanks

FLASH TANKS FOR H.P. CONDENSATE

FLASH TANKS are installed as a major accessory in conjunction with high pressure steam process piping and low pressure steam heating systems. The main purpose of such a tank is to flash high pressure condensate into steam to low pressure heating supply mains, and to curb disturbing pulsations which would otherwise occur if condensate from high pressure returns were directly discharged into low pressure heating return mains.

To determine the required size of a flash tank, the following factors must be known:

1) High pressure condensate in lb per hr.

2) Temperature of high pressure steam.

3) Pressure at which high pressure condensate is to be flashed.

4) Temperature difference between high and low pressure steam.

5) Latent heat of steam at low pressure.

As an example, consider 1000 lb of condensate at 50 psi to be flashed into steam at 5 psi. Find the lb per hr of steam flashed and lb per hr of water released to the low pressure return main.

From tables of the properties of steam, temperature at 50 psi is 297 F and at 5 psi, 227 F. Latent heat at 5 psi is 960 Btu.

$$\frac{1000 \times (297 - 227)}{960}$$

= 73 lb per hr of steam flashed. [This is an approximate method, the error increasing as the pressure drop increases.]

1000 — 73 = 927 lb per hr of water released to low pressure return main.

927/8.0 (weight of 1 gal water @ 212 F) = 116 gph.

116/60 = 1.94 gpm.

Referring to the accompanying table of tank capacities, the size of the high pressure condensate inlet to the tank is determined from the amount of condensate flowing. The size of the low pressure steam outlet is determined from the solved amount of steam flashed as shown in the first step of the preceding example. Trap size on the low pressure condensate outlet is selected from the manufacturer's ratings in accordance with the rate of water released as solved in the second step of the solution.

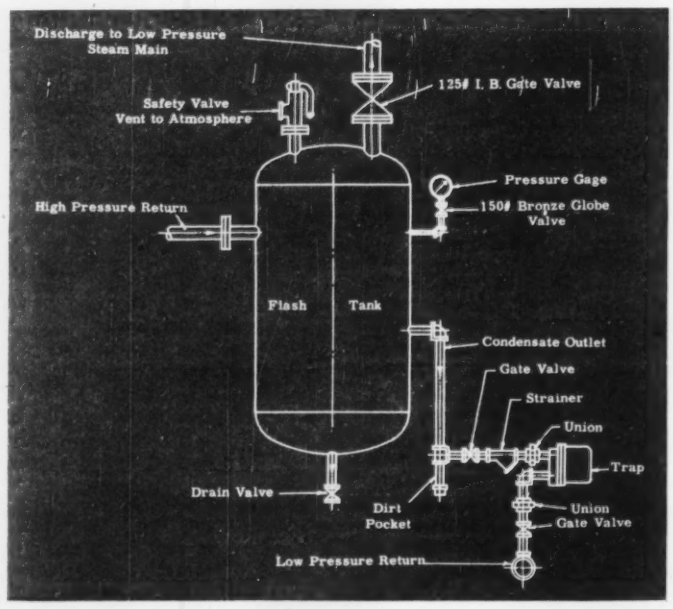
Tanks in sizes 6 to 20 in. diameter inclusive are usually made up of seamless steel pipe, whereas tanks 24 in. diameter and larger are made from steel boiler plate, $^3/_8$ in. minimum thickness, in accordance with ASME specifications for unfired pressure vessels. Tank heads in sizes 6 in. through 20 in. tanks, are standard weight welding caps, and tanks 24 in. and over have standard type dished tank heads.

A second method of determining

Flash tank capacities

Water released, lb per hr	Tank dia., in.	Tank length, in.	H.P. cond. inlet, ips	L.P. steam outlet, ips
100	6	36	1	1
300	6	36	1	1
500	6	36	1	1
750	6	36	1¼	1
1000	6	48	1¼	1
1500	8	48	1½	1½
3000	10	54	2	2
5000	12	60	2½	2½
7500	16	60	3	3
10000	20	48	3	3

Flash tank for high pressure condensate



sizes of flash tanks is as follows:

Condition: 1000 lb per hr of condensate at 50 psi to be flashed into steam at 5 psi.

Find: Lb per hr of steam flashed into low pressure steam main, and lb per hr of water released to low pressure return.

Solution:

[(Heat of liquid @ 50 psi) — (Heat of liquid @ 5 psi)] ÷ [Latent heat of steam @ 5 psi]

267 — 196 = 71 Btu per lb released to make steam.

71/960 = 0.073 of high pressure condensate flashed. 1000 × 0.073 = 73 lb per hr steam flashed. 1000 — 73 = 927 lb per hr water released to low pressure return.

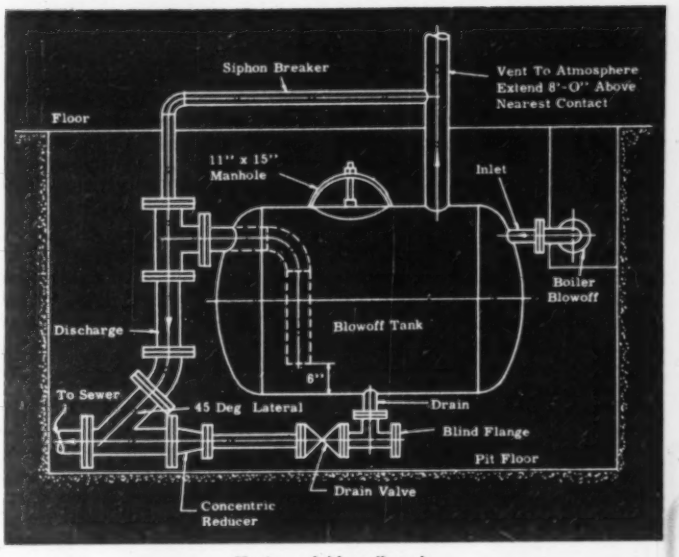
BLOWOFF TANKS AND PIPING

BOILER BLOWOFF tanks, or blowdown tanks as they are sometimes named, are not unlike flash tanks with respect to purpose, size selection, and design. The purpose of a blowoff tank is to intercept steam and water discharged from a boiler through the blowoff main, cool the mixture prior to discharge to the sewer, and to flash the ensuing steam to atmosphere.

The blowoff main size is determined by the number and size of the individual boiler blowoff lines. These individual lines are never smaller than 1 in. and not greater than 2½ in. The main size is equal to the sum of the areas of the smaller lines. The main must connect to the tank at or near the top and it must have a free discharge into the tank, a minimum of at least 6 in. above the maximum tank water level. Valves—other than the boiler blowoff valves—should not be installed in the line; all elbows should be of the long radius type, and all connections to the main should be through 45 deg lateral fittings.

In the design of a blowoff piping system, codes applying to weight of pipe and fittings incorporate that portion of the system which lies between the boiler blowoff valves and the point where pressure is reduced to that approximating atmosphere; in other words, the vented blowoff tank.

The discharge line size, from tank to sewer, should be *twice the area* of the blowoff main size to the tank.

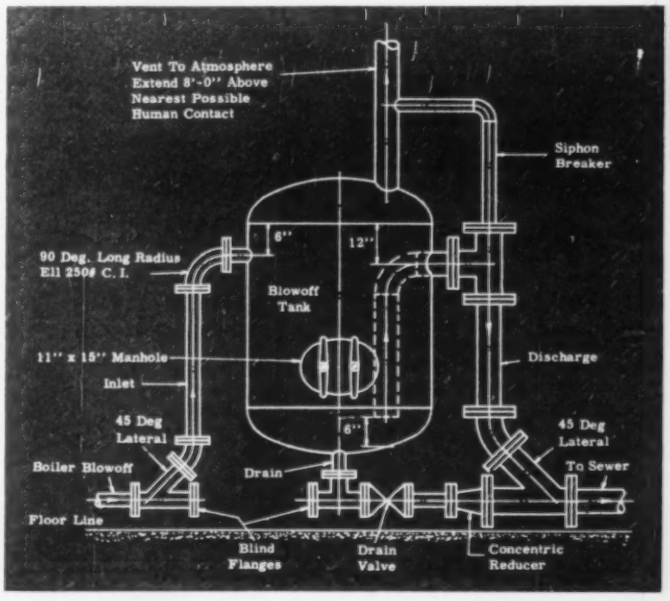


Horizontal blowoff tank

The discharge line should extend to within 6 in. of the tank bottom for the dual purpose of extracting the cooler blowdown water and to provide a seal. The tank discharge line to the sewer should be installed without valves of any type.

The blowoff tank must be equipped with an unobstructed and direct vent to atmosphere. The size of the vent should be *two times the diameter* (four times the area) of the blowoff main to the tank. The vent should extend from the top of the tank to the outdoors and terminate at a location 8 to 10 ft from

Vertical blowoff tank



any window, door, or normal accessible area.

To interconnect the tank discharge to the sewer and the vent line, a siphon breaker equal in size to one-half the diameter of the tank vent should be installed.

To permit periodic inspection by the operator, and to maintain a sludge-free blowoff tank, an 11 in. by 15 in. manhole and a 2 in. drain connection should be provided. The drain line should include a plugged or blind-flanged tee for cleanout, a valve, and the necessary means of increasing the drain line size to conform to the discharge line size.

I do not know of any definite set rule or code governing the size of a blowoff tank, although "rules of thumb" occasionally are published. These rules vary and set the tank size anywhere from a range of 5 percent to 20 percent of the water holding capacity of the boiler, or of a capacity equal to the water volume of one gage on the water column. To size a blowoff tank correctly, the designer would actually have to peruse each individual "boiler room case," much in the same manner a good physician analyzes a patient. This would incorporate the study of such variables as boiler type and characteristics, blowdown, load, and operating pressure.

I have used a set schedule of blowoff tank sizes, either vertical or horizontal application, with success on numerous installations, as follows:

Boiler Horsepower	Tank size Diameter	Length
0 - 150	3'-0"	4'-6"
151 - 250	3'-0"	5'-0"
251 - 600	3'-6"	5'-0"

The type or design of the blowoff tank, either vertical or horizontal, is usually dependent on the plant layout and physical space limitations. Above-floor installations lean toward the use of vertical tanks which require less floor area, whereas below-floor and pit installations are usually horizontal tanks which decrease the amount of excavation.

Blowoff tanks should be constructed in accordance with the ASME code for unfired pressure vessels, from steel boiler plate of firebox quality.

Blowoff tank design and installation boil down to a few easy to remember rules:

Inlet pipe size: Sum of areas of individual boiler blowoff lines.

Discharge pipe size: Two times area of inlet pipe size.

Vent pipe size: Two times the diameter or four times the area of inlet pipe size.

Drain pipe size: 2 in. drain for all tank sizes.

Siphon-breaker pipe size: One-half vent pipe diameter.

Tank size: Refer to above schedule of sizes.

Tank style: Above-floor installation, vertical type; below-floor installation, horizontal type.

EXPLAINS WORKINGS OF OFFICE BUILDING

FEW PERSONS understand the complex facilities and multiple activities that make possible the efficient operation of a modern office building. Public understanding of the interworkings of an office building was furthered by the publication last month of a graphic full-color page advertisement in the Saturday Evening Post.

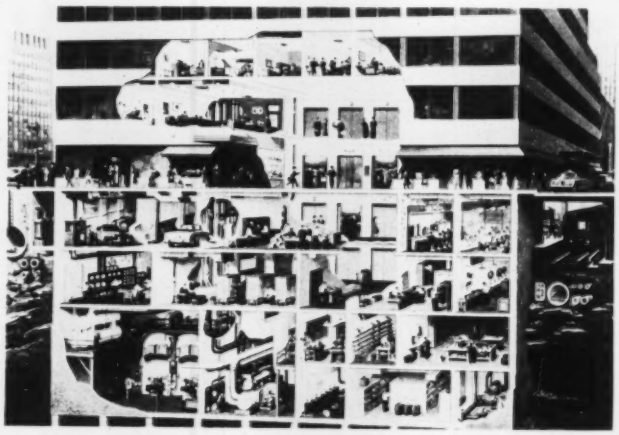
Prepared by the Armstrong Cork Co. in cooperation with the National Association of Building Owners and Managers, the presentation tells briefly the story of an office building's operations. A cutaway view of a typical office building and accompanying diagram illustrating the delivery of heat and cold where they are needed takes readers behind the scenes to see how it's done.

Offered free to readers of the advertisement are 21 x 22 in. enlargements of the cutaway view and explanatory diagram. The enlargements are suitable for framing and may be used by building managers in training personnel and as an explanation to visitors of how an office building operates. The enlargements can be obtained by writing to the Armstrong Cork Co., Lancaster, Pa.

The copy of the presentation reads in part:

"Below ground, a modern office building is a beehive of activity. There you'll find electrical, plumbing, and carpenter shops, employees' locker rooms, control centers, and even a garage. Down deep in the basement, too, are the boilers and compressors that supply heat and refrigeration for the entire building.

"Elevators, telephone lines, electric wiring, along with pipes carrying steam, hot and cold water, and refrigeration travel from basement to top floors through an opening called the 'service core.' This core is really a vertical highway through which move all the services that make a building livable."



SAM LEWIS' PAGE

Converting One of Two Boilers to Gas Firing

INFORMAL comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and member of HPAC's board of consulting and contributing editors

A READER of this "Page" has asked for advice concerning the following problem:

A high school building in a city that has just now been allowed to burn natural gas, wishes to install conversion burners in *one* of two duplicate sectional cast iron boilers while continuing to burn bituminous coal in the other boiler. Both boilers are served by a single chimney of apparently adequate size. The breeching from the boiler most distant from the chimney (let's call it No. 2 boiler) is 20 in. in diameter, increased to 28 in. when the breeching from No. 1 boiler joins it, and continuing as 28 in. to the chimney. The centerline of boiler No. 2 is about 15 ft from the chimney and No. 1 boiler is about 9 ft from the chimney. The No. 2 boiler is rated at 5200 sq ft of steam radiation. The question is: "How to fire boiler No. 2 with gas and still handle the products of combustion without upsetting the draft of coal fired boiler No. 1"?

It is stated that there is not enough room to install a separate breeching for boiler No. 2. It is obvious that it would be difficult in an existing building to build a separate chimney.

Information is given on the make of the sectional cast iron boiler; it is an obsolescent design.

From this statement of facts, I commence with comments and opinions as follows:

The boiler, per an old catalog, is 13 sections long and has approximately 23 sq ft of grate area. It has an inverted bridgewall faced on the front or combustion chamber side with refractory and it has admission ports for secondary air injection at the bridgewall. This boiler was rated in 1929 by its manufacturer at 12,200 sq ft of steam radiation. It has been de-rated considerably to reach the present 5200 sq ft. The Heating, Piping and Air Conditioning Contractors National Association rates it, as of 1949, at 6000 sq ft provided that it is not more than 12 sections long and provided that the coal shall be of 13,000 Btu value per lb. These old boilers are approaching senility.

The design of this boiler is such as to make it deficient in heat absorbing surface, and due to very large relatively unobstructed flue passages, it has low draft resistance. I remember one installation of this boiler where the breeching temperature with ordinary firing at capacity rating averaged 1200 deg.

The Products of Combustion

We are taught that a heating boiler favorable to economy with gas fuel should have decidedly small passages for products of combustion, and that the boiler should interpose rather high resistance to the flow of the products of combustion. After leaving the boiler, the products of combustion may be disposed of without a strong draft and should be diluted by mixing with dry warm air so as to discourage condensation, on the breeching and chimney, of the liquid that is the inevitable result of gas combustion. This liquid is capable of corroding ferrous metal and when allowed to saturate a masonry chimney and then freeze, quickly disintegrates the chimney. Thus, wherever practicable, enlightened engineers demand that chimneys serving gas burning equipment shall have linings impervious to water, and that the breechings shall be resistant to corrosive oxidation.

It will be difficult in this case to install a new lining in the old chimney, especially as the chimney must continue to serve the coal burning boiler No. 1. To burn coal on a grate, a strong draft is required so that air will be forced through the coal bed so as to encourage oxidizing the carbon in the fuel.

Thus, boiler No. 1 needs a strong draft. Boiler No. 2 needs only enough draft to move out the cooled products.

I asked the manufacturer of the conversion type gas burner which it is proposed to use what he would reply to the question. He said, "We have many gas burners in boilers like No. 2 and we do not receive complaints of inefficiency. Just place a barometric type damper, to open and admit boiler room air, at the breeching of boiler No. 2."

I queried, "They must frequently burn coal in boiler No. 1 while at the same time burning gas in boiler No. 2. A barometric damper in boiler No. 2 breeching would admit air so that boiler No. 1 could not receive adequate draft to burn coal and there will surely be trouble." He replied, "They should not try to operate boiler No. 1 on coal at the same time as boiler No. 2 burns gas." I answered, "In severe weather they must run both boilers." He then suggested that ample economy and efficiency and satisfaction surely would be achieved with his conversion burner if someone would merely partly close the outlet

damper in the breeching of boiler No. 2. My answer was to allege that I believed he and his conversion type burner surely would get into trouble when the owner found by experience that efficiency had been side-tracked for expediency, in purchasing equipment to burn gas. He did not appreciate my friendly effort and the interview ended.

Burn Gas in Both?

There is no excuse for trying to burn gas in one of these old kettles while trying to burn coal in the other.

I would install gas in both boilers and would provide an automatic air admission controller either in the main breeching or in the bottom of the chimney to minimize the draft.

If the chimney has walls exposed to the outdoor temperature, it may safely be assumed that eventually the mortar and brick will be spalled off by alternate wetting and freezing, though in so large a chimney the dilution by air from the boiler room will save trouble for a long time.

If, despite my advice, the gas installation must be made in boiler No. 2, I would place in the breeching of that boiler a throttling type damper made of corrosion resistant metal and controlled by a sensitive hydraulic or electric damper regulator, so as to control the draft through boiler No. 2 without weakening the draft of boiler No. 1 and without introducing air into the breeching.

SEES BIG DEMAND FOR HEATING, PIPING, A. C.

IN A "BEGINNING of the year" statement on business in the heating, piping and air conditioning industry, R. W. Lawinger—president of the Heating, Piping and Air Conditioning Contractors' Chicago Association and secretary of the Chicago chapter, National Certified Pipe Welding Bureau—gave his views last month as follows:

"Twelve months ago, many of us were apprehensive as to the outlook ahead and some were downright pessimistic. For heating, piping and air conditioning contractors who live their business lives dealing with hazards, the situation was difficult to predict.

"The general cry then was that the high volume of postwar business just could not continue, and the bottom was about due to fall out. Very few were honestly optimistic. Some eminent economists predicted that general business would drop 10 to 20 percent below the 1948 average.

"Business leaders felt certain that the high level of 1948 business was due for a corrective downward adjustment plus some price reductions. However, the most potent factor was that the nation was returning to a real competitive buyer's market. This was recognized by most business people, including my colleagues in this industry, who promptly took action to improve overall operating efficiency and eliminate unnecessary gingerbread services which have accumulated as a result of war production demands.

"We adjusted our operations to give the best service at lowest possible cost, at a fair profit, in order to justify continued confidence of the buying public. It was the old sound American formula that has made our economy the most successful on earth.

"What was the result? Here is how I count it. The Federal Reserve Board index of industrial production, which uses the average of 1935-39 as base, showed an average of 192 percent for 1948, and for the first 10 months in 1949 an average of 176 percent, which included a low point of 166 percent for October due to the steel and coal strikes. This indicates that general business for the past year was about 8¼ percent below that of 1948. This was as good as could be expected. While no figures are available as to the exact volume of business done by our industry, it seems apparent that it closely paralleled the national trend.

"According to the consumer price index of the Bureau of Labor Statistics, our current dollar in relation to 1935-39 average value is worth about 59¢. Where future money values will stabilize is most uncertain. However, it is my conclusion that there is every indication of a still cheaper dollar, which will be reflected in the general price structure.

"With respect to business volume, there is a tremendous unsatisfied demand for modern heating, process piping, air conditioning and refrigeration, and with both ample money and credit available, 1950 business should be about the same or slightly better than 1949."

A.C. IMPORTANT HEALTH FACTOR

CLEANLINESS OF the air we breathe ranks in importance with the purity of the food we eat and the water we drink, said L. C. Bastian, technical director of the Air Conditioning and Refrigerating Machinery Association, in an address before the weather and building industry conference sponsored by the National Research Council in Washington, D. C., in January. Daily, each of us eats about 3 lb of food and consumes some 4 lb of liquids. In the same period, we take into our bodies about 34 lb of air— almost 10 times as much air as food or drink. Though that large volume of air intake may be heavily laden with contamination, little thought is generally given it as a source of disease infection of many kinds, he stated.

In discussing the importance of controlled air conditions to the human system, Mr. Bastian emphasized that while air temperature, humidity and proper circulation are basic factors, air cleanliness and the shutting out of distracting noise are of almost equal importance.

Pointing out the essentiality of humidity control in providing comfortable and healthful air environment for human beings, he cited as examples conditions in New Orleans and Phoenix. "With a temperature of 95 F and a relative humidity of 60 percent in New Orleans," he said, "the average person is more uncomfortable than he would be in Phoenix with a temperature of 105 F and a relative humidity of 25 percent."

"When people realize the great health benefits inherent in air conditioning—relief from oppressive heat and humidity; the shutting out of harmful dirt and dust swirling in through open windows; the blessing of a restful night's sleep; the surcease from unnecessary torment for the sick, the very young and the aged—when these benefits are fully realized, then summer air conditioning will be generally considered as essential to the home as winter heating," he concluded.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Baseboard Radiation Performance in Occupied Dwellings

By G. S. MacLeod* and C. E. Eves**,
Chicago, Ill.

SUMMARY—In order to determine the performance of baseboard radiation in field installations, tests were conducted in several houses of diversified construction. Winter comfort conditions obtained were evaluated by the observation of the interdependent factors of air temperature distribution, room air velocity, mean radiant temperature, and relative humidity, as well as from the comments of the occupants of the houses studied. An outline of field test procedure and a description of test equipment are given as a basis for future work.

PREVIOUS papers by Kratz, Harris and Weigel [1,2] concerning performance of baseboard radiation have reported laboratory and test house findings. It was felt that the next logical step in furthering the knowledge of this branch of the heating art would be a study of baseboard radiation performance in a variety of occupied dwellings. The purpose of this paper is to present test data gathered during such a study.

In conducting these tests, it was considered important that any household activities which might influence temperature or humidity conditions should be carried on at the pleasure of the occupants.

Test Program

Five houses of varied size, shape, and construction were chosen as subjects for this study. In view of the fact that the occupants of these houses were under no obligation to the sponsors of the project, several considerations influenced the planning of the program and the choice of instrumentation. The more important of these factors were:

1. No damage to decorations or furniture would be permissible.
2. No permanent test equipment could be installed.
3. All apparatus must be readily transportable.
4. A minimum of interference with occupants' normal activities would be allowable.
5. One week in each house was considered the maximum time in which to gather data.

The general program for each house was as follows:

First day. Set up instruments, made fuel-consumption and combustion-efficiency tests, drew floor plans, calculated house heat loss, and started automatic recording instruments.

Second, third, and fourth days. Took four complete cycles of manually-recorded data each day. Cycles were started at 7:00 a.m., 11:00 a.m., 3:00 p.m., and 7:00 p.m.

Fifth day. Dismantled and packed apparatus, and obtained general comments from the occupants regarding their reactions to, and their experiences with, the baseboard heating system.

Test Equipment

Houses. The five houses chosen for this project represented a fair cross-section of the types of North American single dwellings in which baseboard radiation might logically be installed. The number of rooms heated ranged from five to fourteen. The number of occupants ranged from two to six. Three of the houses were heated entirely by means of baseboard radiation. The other two had small amounts of standing radiation. Three of the systems were oil-fired, one was gas-fired, and one was coal, stoker-fired.

*Test Engineer, Sears, Roebuck and Co. Member of ASHVE.
**Former Test Engineer, Sears, Roebuck and Co.
[1,2] Exponent numerals refer to references.
Presented at the 56th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Dallas, Texas, January, 1950.

Case No. 1

Case No. 2

Case No. 3

Case No. 4

Case No. 5

Fig. 1—Exteriors of the five dwellings (Cases Nos. 1 to 5)

Figs. 1, 2, and 3, and Table 1 present more detailed information.

Radiation. The radiator sections used in this study were of hollow steel, shaped to resemble wood baseboard. The nominal length of each section was three feet; the height of the front face was about nine inches. No provisions were made for convective air currents between the radiator sections and the walls on which they were mounted. As may be seen in Fig. 2, the radiation was installed on exposed walls where conditions would permit. Forced hot water was the heating medium used in all of the five systems.

Instruments and Controls Used in Test Program

Controls. Operation of the circulating pump in four of the systems was controlled by a snap-action

Legend for Fig. 1

Case No. 1—Southwest view. *Walls:* Frame with wood siding and sheathing exterior; painted plaster board interior. *Ceiling:* Flat, built-up tar and gravel on wood sheathing; vented above insulation; painted plaster board interior. *Floor:* Wood floors on joists over basement in north half of house; asphalt tile on concrete over gravel fill in south section of house. *Insulation:* 3⅝ in. rockwool bats in ceiling; 1 in. cotton bats with reflective surface in all exterior walls. *Boiler Location:* in basement below northeast bedroom.

Case No. 2—Northeast view. *Walls:* Frame with wood siding and sheathing exterior; lath and plaster interior. *Ceiling:* lath and plaster, unfloored attic above. *Floor:* Wood floors on joists over full basement. *Insulation:* 3⅝ in. rockwool bats between joists in ceiling; loose rockwool in exterior walls. *Boiler Location:* in basement below bathroom.

Case No. 3—Northwest view. *Walls:* first floor, brick veneer with plaster on plaster board interior; second floor, frame. *Ceiling:* plaster on plaster board interior, unfloored attic above west half of first floor; ceiling of second floor, plaster on plaster board under rafters. *Floor:* Wood floor on joists over full basement. *Insulation:* 2 in. vegetable fiber bats in all exposed walls and in ceiling over west half of first floor. *Boiler Location:* in basement below garage.

Case No. 4—Southwest view. *Walls:* Frame, brick veneer, or stone veneer exterior; lath and plaster interior. *Ceiling:* lath and plaster under partly floored attic. *Floor:* wood floor on joists over full basement. *Insulation:* 3⅝ in. rockwool bats in all exterior walls and between ceiling joists. *Boiler Location:* in basement below playroom.

Case No. 5—East view. *Walls:* brick veneer exterior; 1 in. knotty-pine panel or lath and plaster interior. *Ceiling:* lath and plaster under flat, "built-up" roof. *Floor:* terrazzo on joists over half-basement. South wing of structure over a three-foot crawl space. *Insulation:* 6 in. loose mineral wool between ceiling joists only. *Boiler Location:* in basement below west bedroom.

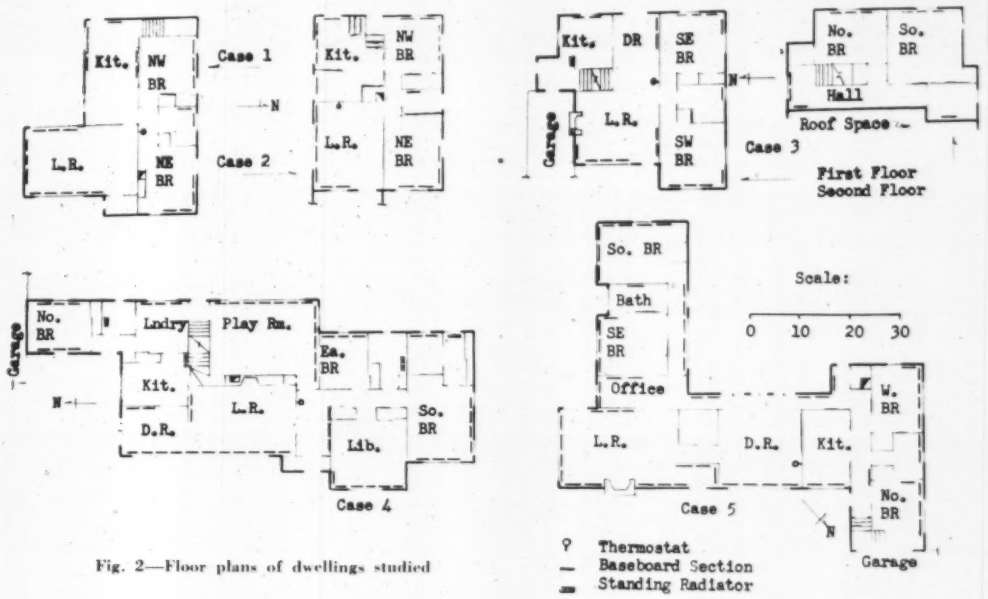


Fig. 2—Floor plans of dwellings studied

room thermostat. An immersion thermostat controlled the firing device so that the boiler water temperature was maintained between 180 and 200 deg.

In the other system, the circulating pump operated continuously, and the oil-burner was controlled by the room thermostat.

Instrumentation, Recording. A recording potentiometer and copper-constantan thermocouples were used to obtain continuous temperature data of the following: ice bath for 32 F reference; outside air in the shade; south vertical outside surface of the building; south vertical sol-air temperature of a black surface; room ambient of the thermostat; living room radiator surface, outlet; living room radiator surface, inlet; boiler inlet pipe surface; and boiler outlet pipe surface.

The operating periods of the circulating pump, and the periods and total operating time of the firing device, were recorded during the entire test period at each house.

Instrumentation, Indicating. Combustion efficiency and fuel consumption determinations were made on each installation before the actual test cycles were begun. No adjustments were made to firing device during the balance of the test.

A portable potentiometer and test stands (see Fig. 4) were used in determining the room air temperature and the radiation-convection temperature. Four No. 30 iron-constantan thermocouples were suspended from each stand, two at the 3-in. level and two at the 48-in. level. One of these at each level was placed in the center of a copper globe, which had been painted with two coats of a standard flat black. Two previous papers,[3,4] describe the details and use of globe thermometers. The other thermocouple at each level was suspended in the air about one inch from the periph-

Table 1—House Details

1. Case Number	1	2	3	4	5
2. No. heated rooms	5	6	10	14	13
3. Stories	1	1	1½	1½	1
4. Floor area, sq ft	954	937	1531	2413	2133
5. Heated volume, cu ft	7518	7678	11,836	18,669	17,770
6. Glass & door area, sq ft	212	158	352	613	504
7. Total heat loss (80 F diff.)	42,300	35,000	92,700	91,100	113,600
8. Percent total heat loss:					
a. Walls	20.8	37.8	19.7	13.7	22.0
b. Ceiling	18.0	17.1	27.3	19.2	5.8
c. Floor	16.2	1.1	4.3	1.8	11.5
d. Infiltration	19.5	17.0	14.5	20.2	20.9
e. Glass & doors	25.5	27.0	34.2	45.1	39.8
9. Ceiling height, in.	97	102	96	96	100
10. Insulation	Full	Partial	Partial (Not completed)	Full	Partial
11. Fuel used	Oil	Gas	Coal (Stoker)	Oil	Oil
12. Basement	½ Exc. - ½ Con. Slab	Full Exc.	Full Exc.	Full Exc.	½ Exc. - ½ Crawl Space

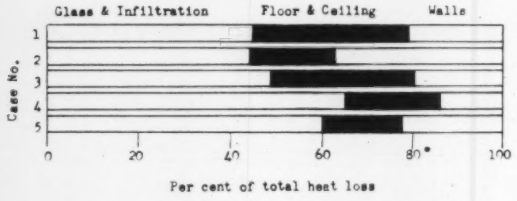


Fig. 3—Percent of total heat loss

ery of its nearest globe. Lead wires from the four thermocouples on each stand terminated in an eight-contact plug near the base of the stand. One of these test stands was placed midway between the intersection of the living room diagonals and each corner. In each of the other heated rooms one stand was placed as near the center of the room as furniture would permit.

When the 3 in. diameter globes and the 8 in. diameter globes were suspended within a few inches of each other, so that neither one shaded the other from the main source of radiant heat, the observed globe temperature of the 8 in. was of the order of 1½ deg higher than that of the 3 in. globe. Thus, the mean radiant temperature (MRT) of the 8 in. globe was also higher under the same conditions. However, for convenience in transporting and to inconvenience the occupants less, the smaller size globes were used for most observations. Air temperature variations, both horizontally and vertically, were so small that an unshielded single thermocouple was considered sufficiently accurate for the purposes of this project.

Air temperatures at the 3-in.-below-ceiling level were taken directly above each test stand by means of a thermocouple taped 3 in. from the end of a long rod.

A selector-switch box and 20-ft lead wire extensions, having appropriate plugs and sockets, made it possible to connect and disconnect lead wires quickly and to make many temperature observations without moving the switch box or potentiometer. Also, the hazard of occupants tripping over wires was reduced to a minimum.

A thermo-anemometer was used to determine the velocity of the room air at a point within 2 in. of each black globe. An air-velocity traverse was also taken in the living room of each house in the four vertical planes established by the test stands, 30 in. above the floor, at the following points: 3 in. and 12 in. from the outside wall, and 12 in. and 3 in. from the inside wall.

The wet and dry bulb temperatures at the center of the living room were observed each period by means of a sling psychrometer. Atmospheric pressure readings were obtained from an aneroid barometer. The direction and velocity of the wind were determined with a velometer and compass. Weather data such as rain, snow and cloudiness were also observed and recorded.

Discussion of Results

Winter Comfort Conditions. A thorough discussion of what constitutes comfort in a heated structure is outside the scope of this paper. However, at least the measurable, physical factors that influence the sensation of comfort must be considered in an evaluation of heating system components.

Published papers pertaining to winter comfort indicate that among the more important of these influencing factors are the following: temperature of the air; air velocity; mean radiant temperature; and relative humidity.

In the broad sense, winter comfort conditions actually imply a state of equilibrium between the heat losses of the human body and the heat gains. Consequently, maintaining winter comfort resolves itself into the control of the *net effect* of as many of the influencing factors as possible, and over as much of the occupied area of the structure as possible.

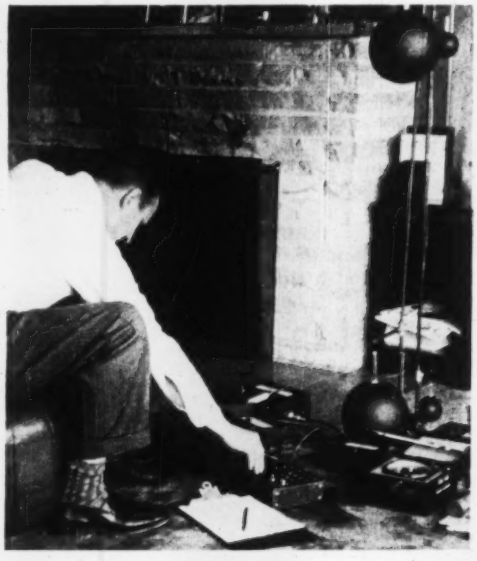


Fig. 4—Indoor test apparatus

Legend for Fig. 5

A = Gravity hot water heating system with radiators.
B = Electric heater with gravity circulation through a plenum chamber.
C = Electric heater with forced circulation (780 cfm) through plenum chamber.
D = Oil furnace with forced circulation through plenum chamber.
E = Gas space heater with a disk fan.
F = Forced hot water using baseboard radiators.

All occupants of the houses studied agreed that they knew of no other type of heating system that maintained such uniform, comfortable conditions in a dwelling. These human reactions, though they do not lend themselves to scientific measurement and evaluation, are an indication of the achievement of the result hoped for, *i.e.*, the control of the *net effect* mentioned previously. Perhaps the ensuing discussion of the individual influencing factors will explain the occupants' reactions.

Discussion of Temperatures

Air Temperature Distribution. Dr. E. U. Condon, director of the National Bureau of Standards makes the following comment in a Bureau publication[3], "Uniformity of temperature throughout houses is a tacitly accepted American ideal of heating, ...". As that publication deals almost entirely with air-temperature variations in a test bungalow somewhat similar from a heating standpoint to the first two houses studied in this baseboard radiation project, the data contained therein were used as a basis for comparing the baseboard performance.

Fig. 5 shows that the average air temperature differences from floor to ceiling in the baseboard-heated homes were appreciably less than those in the Bureau of Standards test house when using other types of heating systems.

In a few instances during the baseboard radiation tests, the air temperature near the ceiling was observed to be lower than that near the floor. In the summary of test data (Table 2) these cases are referred to as *temperature inversions.* This phenomenon would probably not occur in structures heated with the more conventional systems. However, as floor-to-ceiling differentials approach zero, and as the convection effect decreases, radiant heat from the sun coming through large glass areas would tend to raise the temperature of the floor and rugs, and indirectly the air temperature near the floor, without a corresponding increase in temperature of the air near the ceiling.

These temperature inversions were not included in the averages of air temperature differences as it was believed that doing so would influence the averages unfairly.

The 3 deg floor-to-ceiling difference observed in this project agrees substantially with the results of baseboard radiation tests at the University of Illinois as reported by Kratz and Harris[1], and by Weigel and Harris[2].

It was also observed that in Case No. 4 in the taree rooms heated with free-standing, thin-tube radiators, the vertical air temperature differences were in the 9-to-11 deg range.

The variation in temperature from room to room at various levels was small, considering the fact that the water flow rate to individual radiators had not been finally adjusted in any case by means of balancing valves. Most horizontal differences observed were between two and four degrees when no unusual conditions prevailed.

These near-zero differentials occurred under diverse conditions of floor construction and glass area.

The satisfactory heating of rooms with concrete slab floors agrees with the observations of Weigel and Harris[2] at the University of Illinois who state, *the radiant baseboard is particularly adapted to maintaining comfortable floor slab temperatures in a basementless structure.* . . . . .

Room Air Velocity. In the 1949 edition of the HEATING, VENTILATING, AIR CONDITIONING GUIDE, p. 783, the

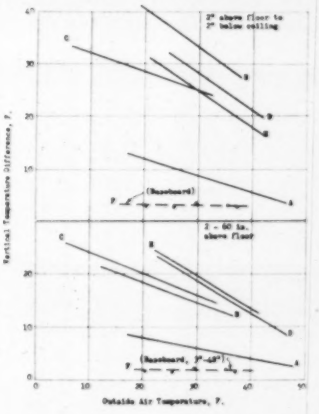

2" above floor to 2" below ceiling
(Baseboard)
2 - 60 in. above floor
(Baseboard, 3"-48")
Vertical Temperature Difference, F.
Outside Air Temperature, F.

Fig. 5—Average vertical temperature differences observed in five baseboard-heated dwellings. Data superimposed on a reproduction of Fig. 10 of Bureau of Standards report BMS-108
(Reproduced by permission of the National Bureau of Standards.)

following statement is made, *velocities less than 15 fpm generally cause a feeling of air stagnation, whereas velocities higher than 65 fpm . . . . . may result in a sensation of draft.* It will be noted from the summary of test data (see Table 2) that the averages of velocities at the room centers were between 17 and 24 fpm at the 3 in. level, and between 9 and 14 fpm at the 48 in. level. However, no user complained of any stagnant air conditions. Velocity observations at points directly above the baseboard radiators and at other points in the rooms showed only slight departures from the values at the room centers.

Mean Radiant Temperature. The mean radiant temperature (MRT) of an environment has been defined in a previous ASHVE paper[3] as the *temperature of a uniform enclosure with which one's body would exchange the same amount of energy by radiation as in the actual environment.* Professor Mackey[4] shows that a small globe thermometer, 48 in. above the floor and at the center of a room, *gives closely, the mean radiant temperature influencing radiant heat transfer from the standing human body.* The majority of globe temperatures

observed in the baseboard-heated rooms were within one degree of the temperature of the surrounding air.

The MRT of structures heated by conventional systems generally decreases with a decrease in outside temperature. Thus, air temperatures in a room must be increased on cold days and decreased on mild days to achieve the same sensation of warmth. However, in spite of a wide variety of outside temperatures, nearly constant mean radiant temperature and air velocity conditions were encountered in the houses studied. As a result, control of the air temperature alone by means of an ordinary room thermostat satisfactorily governed the comfort conditions during the heating season. This was significant in that it indicated that no complex temperature control apparatus was required for this type of heating system.

Relative Humidity. Averages of the living room relative humidity observations for the five houses ranged from 37 to 47 percent. Nearly all of the individual observations, when plotted against outdoor air temperatures, were above the average of 3050 observations reported by Phillips[6] of the Bureau of Standards in a survey of conditions in 215 residences in the Northern United States.

Solar Radiation and Temperature Distribution

Effect of Solar Heat Gain. Bright sunlight shining through an unshaded glass area would naturally tend to raise the temperature of most objects in its path. The effect of solar radiation was noticed mainly on the globe thermometers, and to a lesser extent on the air temperature. When an individual is comfortable in a shaded portion of a structure, then moves into a position where direct sunlight reaches his body, he will probably have an uncomfortable sensation of warmth. Obviously then, sunlight may be expected to have an effect on comfort conditions in localized

Table 2—Summary of Test Data

Case No.	1		2		3		4		5	
Test date, 1949	2/8-2/11		2/15-2/17		2/22-2/25		3/1-3/4		3/8-3/11	
Average vertical temperature difference, F:										
3 in. above floor to 48 in. above floor	1.9		1.4		2.2		2.3[a]		1.5	
3 in. above floor to 3 in. below ceiling	2.9		2.4		3.0		3.3[a]		2.4	
Average of the maximum horizontal air temperature differences:										
3 in. above floor	6.1		3.7		4.0		6.4		4.5	
48 in. above floor	4.9		3.1		5.4		6.2		3.9	
3 in. below ceiling	4.2		3.4		—		—		—	
Average air velocity, all rooms, fpm										
3 in. above floor	21.8		21.0		17.7		23.2		23.0	
48 in. above floor	9.5		12.7		12.7		12.0		13.4	
Maximum air velocity, fpm										
3 in. above floor	70		44		45		110[b]		60	
48 in. above floor	25		21		27		22		26	
Average relative humidity (living room), percent	37		43		47		37		46	
Average outdoor temperature in shade, F	20.5		25.5		35.2		29.6		37.0	
Average indoor temperature (at thermostat), F	73.0		73.0		70.0		71.0		71.0	
Indoor-outdoor temperature difference, F	52.5		47.5		34.8		50.4		34.0	
Average heat loss during test period, Btu hr	27,800		20,800		40,300		57,400		48,300	
	3 in. - 48 in.	3 in. flr- 3 in. clg.	3 in. - 48 in.	3 in. flr- 3 in. clg.	3 in. - 48 in.	3 in. flr- 3 in. clg.	3 in. - 48 in.	3 in. flr- 3 in. clg.	3 in. - 48 in.	3 in. flr- 3 in. clg.
Test averages of vertical temperature differences, F:										
Living room, N.E. area	4.3	6.2	1.4	2.0	2.7	3.8	1.8	2.5	1.7	3.4
Living room, S.E. area	2.6	3.4	1.8	1.9	2.7	3.8	1.8	2.4	2.0	3.4
Living room, S.W. area	1.1	3.0	0.9	1.2	3.9	4.8	2.3	3.3	2.0	2.7
Living room, N.W. area	4.1	4.7	1.3	1.0	2.6	3.4	1.9	3.0	1.7	2.5
Living room, average of 4 areas	3.2	4.3	1.3	1.7	3.0	3.9	1.9	2.8	1.9	3.0
Dining Room	—	—	—	—	2.6	3.5	4.3	6.3[d]	1.9	3.0
Kitchen	2.0	3.2	1.0	2.1	3.2	3.7[c]	4.4	9.1[c]	2.3	4.5[c]
Bathroom	0.8	1.7	1.0	2.1	1.7	2.9	5.1	11.3[c]	2.0	2.9
Northeast bedroom	1.6	2.7	1.5	1.8	0.8	1.2	2.1	3.4	1.2	2.0
Northwest bedroom	1.9	2.6	0.8	1.5	—	—	—	—	1.8	2.4
Southeast bedroom	—	—	—	—	3.9	4.9	—	—	0.7	1.3
Southwest bedroom	—	—	—	—	2.5	3.6	—	—	1.4	1.9
No. of vertical temperature inversions observed[f]	15	4	9	5	2	1	2	5	5	4
Percent of total difference observations	15	4	13	7	2	1	2	5	4	3
Average amount of inversion, F	1.4	1.1	0.6	0.7	0.2	0.3	3.3	0.8	0.6	0.7

[a] includes baseboard-heated rooms only.
[b] near open fireplace.
[c] heated with standing radiation.
[d] opens into room heated by standing radiation.
[e] baseboard radiators behind cabinets.
[f] temperature inversion: when air temp. at floor is greater than at higher levels.

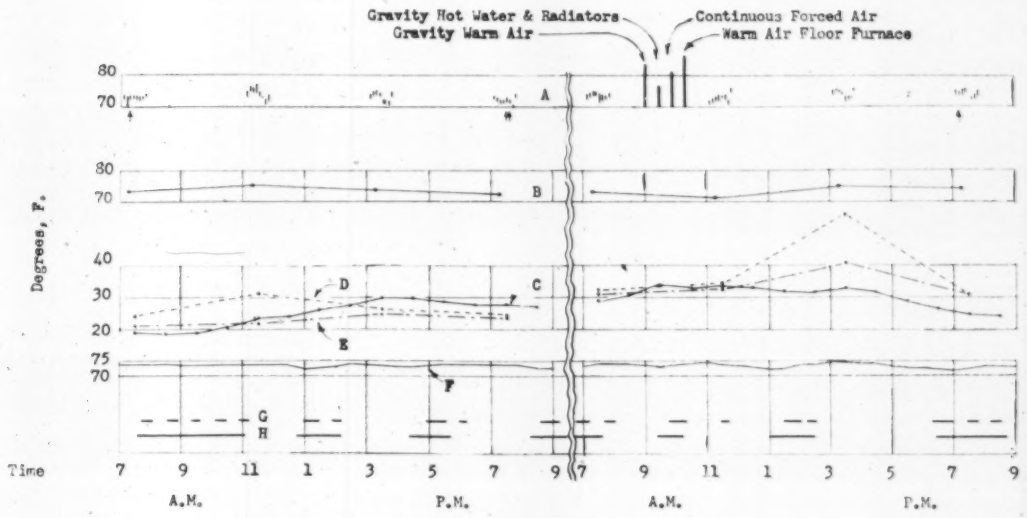


Fig. 6—Typical log of test data, case no. 2

EXPLANATION

A. Short lines in chart A represent room air temperatures and differences between floor and 48 in. levels. The lower end of each line represents ambient temperature 3 in. above the floor; upper end shows temperature 48 in. above the floor. (Exceptions: arrows indicate *temperature inversions* where 48 in. temperature is lower than that near the floor.)
The four heavy vertical lines represent the average vertical air-temperature differences (at 32 F. outdoor) from 3 in. to 60 in. above the floor in the U. S. Bureau of Standards Test Bungalow, using a variety of heat distributing systems. (From Bureau of Standards Report No. BMS-108, page 13.)
B. Mean radiant temperature of the living room, at room center, 48 in. from floor.
C. Temperature at Chicago Airport, U. S. Weather Bureau Station.
D. Sol-air temperature of a black surface, south vertical exposure.
E. Outdoor air temperature in the shade as observed near test house.
F. Air temperature at thermostat.
G. Burner operating periods.
H. Circulator operating periods.

areas, regardless of the heating system. However, no general effect of solar heat on the temperature distribution within a house was observed during this series of tests.

Self-Balancing Effect. Case No. 3 presented a number of interesting conditions that would indicate the satisfactory operation of baseboard systems under the most adverse circumstances. This house, though occupied was still in the process of construction. A tarpaulin covered the west entrance to the garage. The north wall of the living room consisted of plaster on plaster board, and was exposed to the cold garage. There was free circulation of air from the garage to the uninsulated space above the living room, the southwest bedroom, and part of the bathroom. Thus, under the conditions prevailing at the time of the test, the living room and the southwest bedroom had an inadequate amount of radiation.

In spite of this lack of balance, both the vertical and horizontal temperature differences compared favorably with the other houses where the conditions were more nearly in balance. This would lead to the conclusion that when there is free communication between rooms within a structure, and the *total* amount of baseboard radiation is sufficient to offset the *total* heat loss of the house, satisfactory temperature distribution can be achieved, even when the amount of radiation in some rooms is unequal to the heat loss of the corresponding rooms.

Conclusions

The test results indicated the following general conclusions:

1. Size, shape, or construction materials of the structures had little effect on the overall performance of the baseboard radiation.

2. Air temperature differentials from floor to ceiling and from room to room were less than in houses heated by more conventional systems.

3. Baseboard radiation systems were free from inherent drafts.

4. Indoor relative humidity was observed to be satisfactory without the use of humidification devices.

5. Highly satisfactory results were obtained from the use of simple control systems.

The highly satisfactory comfort conditions reported by the occupants of baseboard-radiation heated residences were generally substantiated by the physical measurements of the thermal environment.

It is hoped that the work on this field project will contribute to the overall knowledge of the heating art, and that those readers interested in pursuing the subject will draw upon the experience of the authors.

The conclusions offered are neither final nor complete, but do indicate that baseboard radiation presents some interesting phenomena which justify further inquiry.

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DR. C.-E. A. WINSLOW RECEIVES F. PAUL ANDERSON MEDAL

At the 56th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in Dallas, January 23-26, 1950, Dr. C.-E. A. Winslow, New Haven, Conn., was awarded the F. Paul Anderson Medal. The medal, presented by Alfred E. Stacey, Jr., president of the Society, was given to Dr. Winslow at the Annual Banquet, held Wednesday evening, January 25, at the Baker Hotel, Dallas.

Dr. Winslow was selected for the award because of his distinguished contributions to the arts and sciences of heating, ventilating and air conditioning as an author, teacher, physiologist and research director.

The F. Paul Anderson Medal was created in 1930 by the late Thornton Lewis, Philadelphia, and is awarded to ASHVE members in recognition of notable scientific achievement or outstanding services performed in the field of heating, ventilating or air conditioning. Since 1932, medals have been awarded to seven Society members as follows: W. H. Carrier, chairman of the board, Carrier Corp., Syracuse, N. Y.; Dr. A. C. Willard, president-emeritus, University of Illinois, Urbana; Prof. F. B. Rowley, director, Engineering Experiment Station, University of Minnesota, Minneapolis; Dr. F. E. Giesecke, New Braunfels, Tex.; the late F. C. Houghten, Pittsburgh, Pa.; A. E. Stacey, Jr., Syracuse, N. Y.; and the late J. H. Walker, Detroit, Mich.

Dr. Winslow was born February 4, 1877 in Boston, Mass., and received his B.S. and M.S. from Massachusetts Institute of Technology, and

Dr. C.-E. A. Winslow

Dr. P.H. from New York University. From 1898 to 1910, he taught in the Department of Biology and Public Health, M.I.T. From 1910 to 1915 he was associate professor of biology, College of the City of New York. From 1915 to 1945 he was the Anna M. R. Lauder professor of public health at Yale University, School of Medicine, and chairman of the Department of Public Health. He is now professor emeritus of public health, Yale School of Medicine. Dr. Winslow for many years served as Director of Research of the John B. Pierce Laboratory of Hygiene, New Haven, Conn. He has been editor of the American Journal of Public Health since 1944. He was chairman of the New York Commission on Ventilation from 1913 to 1923.

He is a past president of ASHVE and in 1948 received a Life Membership certificate. He has served on the ASHVE Council and on many Technical Advisory Committees. Dr. Winslow has conducted researches and published numerous papers on relation of atmospheric conditions to human health and comfort, including ventilation. He has presented numerous technical papers before the ASHVE which appear in the Society's Transactions. He is also the author of numerous papers appearing in medical and health journals and other publications. He has co-authored the book, "Temperature and Human Life" with L. P. Herrington, published in 1949.

Dr. Winslow received the Sedgwick Memorial Medal of the *American Public Health Association* in 1942, and he is listed in *Who's Who in Engineering* and *Who's Who in America*.

John R. Allen Memorial Library

The ASHVE Committee on Research gratefully acknowledges the following gifts to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

The B & G Handbook, by the Bell & Gossett Co. Gift of the company.

Radiant Heating, by T. Napier Adlam. Gift of the author.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields, by authors and others, will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

Fitting Losses for Extended-Plenum Forced Air Systems†

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SUMMARY—A large number of fittings was studied for losses when attached to an extended plenum trunk duct. In connection with a single size of trunk and branch duct, three general types of fittings were tested: (1) 90-deg side take-offs; (2) 45-deg side take-offs; and (3) top take-offs.

These tests indicate that the use of conical take-offs is desirable with the opening in the trunk duct larger than the branch duct opening. It is also shown that the sharpness of the turning angle should be reduced at the entry to the take-off. Applying these principles to the design of a fitting markedly improves the loss characteristic when compared with a butt take-off.

AIR CONDITIONING systems both summer and winter require the delivery of conditioned air from the unit to the air distributing devices located in the room, such as registers, diffusers, plaques, etc. The branch ducts supplying these air distribution devices commonly consist of round pipes, wall stacks, or rectangular ducts, the sizes of which are determined by the air volume requirements for the space to be conditioned; and the shapes of which are frequently determined by space limitations. The frictional resistances, and pressure losses, of these branch ducts and fittings have been fairly well established.[1,2,3]

The trunk which connects the branch ducts to the conditioner, or to the plenum attached to the conditioner, can consist of:

1. a non-uniform size arrangement in which the cross-sectional area is decreased following each branch take-off connection. As shown in Fig. 1*b* this arrangement requires several different trunk sizes and a number of complicated fittings.

2. a smaller, uniformly sized plenum, shown in Fig. 1c which is designated as an extended plenum. In this case the cross-sectional area of the plenum is approximately equal to that of the inlet. This arrangement consists of a single size of trunk and relatively simple branch take-off fittings. Since a single size trunk is used on a given installation and a small number of fittings is required, the installation is relatively simple and less costly than the more complicated arrangement shown in Fig. 1*b*.

3. a large, uniformly sized plenum, such as is shown in Fig. 1*d*, and which has been designated as a box plenum. This type of plenum refers to that having a large cross-sectional area relative to the inlet area. The box is of rectangular construction without transition sections, and the branch take-off fittings consist of simple, butted connections. Pressure loss and air flow characteristics of a box plenum have been reported.[4]

However, information dealing with the pressure loss and air flow characteristics of the extended plenum type of duct system has not been available. The present investigation, therefore, has been devoted to a study of the extended plenum and its take-off fittings. The emphasis has been largely devoted to the size and shape of the junction or take-off fitting between the extended plenum and the branch duct, since the fitting resistance can be a substantial portion of the total resistance of the system when unfavorable forms are used. The objective of this investigation, therefore, was to determine shapes of take-off fittings which not only would give good performance, but also would be simple in construction. In view of the fact that an unlimited number of combinations of branch ducts and extended plenum are possible, it was necessary in this preliminary study to confine the investigation to a single arrangement of branch and plenum. For this purpose a single branch duct was connected to a 12 in. × 8 in. extended plenum. A large number of branch take-off fittings were tested over a range of air quantities, and pressure losses were determined across the branch fitting. Losses in the trunk duct across the take-off fitting were also studied but have not been included in this paper.

Analysis of Tests Made by Previous Investigators

The losses at a junction between a trunk duct and a branch duct can be considered as being com-

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†This investigation is a part of the cooperative project jointly sponsored by the Engineering Experiment Station of the University of Illinois and the *National Warm Air Heating and Air Conditioning Association*.

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[1]Exponent numerals refer to References.

Presented at the 56th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Dallas, Tex., January 1950.

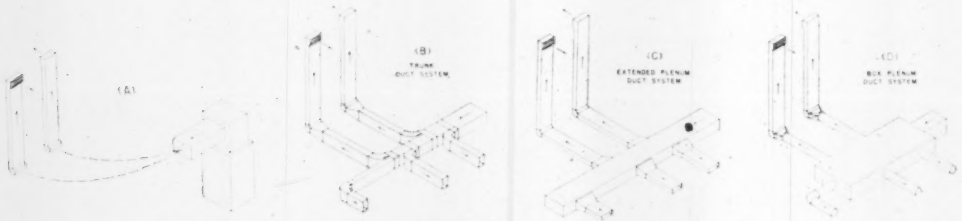

Fig. 1—Three types of duct systems

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posed of both friction losses and mixing losses, not only for the flow in the branch duct but also for the flow in the trunk duct. Of the two component losses, the mixing losses usually dominate, and occur when an unstable flow pattern changes to a stable velocity distribution as a result of internal friction. For example, if the flow in the branch duct is abruptly or sharply turned in direction, the inertia of the flowing mass will produce a separation of the stream from the wall, with the resultant formation of a vena-contracta section at some distance downstream. The stabilization of this non-uniform velocity profile is accompanied by a mixing loss. In the same manner, the diversion of part of the flow from the trunk duct into a branch duct, results in a disturbed velocity profile in the trunk duct, and the subsequent stabilization of flow in the trunk duct is accompanied by a mixing loss.

If the flow pattern for a given fitting were exactly known, or could be predicted, a computation of the loss could be made by means of the momentum equation. For example, in the case of a water jet issuing into air in which a sharply defined boundary exists between the two fluids, the free-streamline method introduced by Helmholtz and later used for special problems by Kirchhoff, von Mises,[3] and others could be used in the analysis of the flow at the junction of the jet and the pipe. However, the method is limited in application to rather simple two-dimensional cases involving sharply defined boundaries of the issuing jet, and for constant pressure existing at the free surface. The analytical approach proves inadequate in those cases where the jet surface is not sharply defined, and an unstable discontinuity in the fluid disintegrates into eddies, such as is the case when an air jet issues into air, or when a water jet issues into water.

An analytical method was used by Vazsonyi,[4] in which the equation of motion was replaced by the momentum equation for the solution of problems dealing with flow in miter elbows and branch take-off fittings from a trunk duct. The assumption was made not only that the velocity profile was fairly equalized across the duct, but also that the pressure distribution across the containing walls of the duct was equal. Since considerable uncertainty exists in these basic assumptions, any analysis of this nature must be modified by correction factors determined from actual tests.

The use of small-scale models of ducts and fittings has been common in flow experiments. A general requirement of such model tests is that geometrical similarity must exist between the model and the prototype not only in the overall dimensions of the unit under test, but also in the smallest details of the unit. For example, the relative roughness of the walls must be the same for both model and prototype. The results of tests on the models made under these conditions can then be extrapolated to conditions anticipated for the prototype by the application of a correlation number or model law. For the case under consideration in this paper in which the influences of compressibility and heat transfer are negligible the Reynolds correlation would be applicable. However, as will be discussed later, the results of previous investigations[7,8,9,10,11] seem to indicate that even the Reynolds Number has but little significance as far as the junction losses are concerned.

Previous tests on junction losses, such as those reported by Thoma, director, Munich Hydraulic Institute, and his associates[7,8,9,10] have been confined to round branch pipes and were made with water. The test installation, which has been described by Petermann,[8] consisted of a trunk 43 mm in diameter (approximately 1.7 in.) and three separate branch pipes, 15 mm, 25 mm, and 43 mm. The branch junction was located approximately 47 diameters from the intake section of the trunk. The upstream measuring station was about 38 diameters from the intake section and sufficiently far from the intake to obtain a stable velocity profile. The downstream measuring station in the trunk was 63 diameters from the intake. The downstream measuring stations in the branch were from 45 to 75 diameters downstream from the junction, and were also located at sections having a stabilized velocity profile. The difference in total head at the upstream

and downstream measuring stations for both trunk and the branch pipe included, therefore, some amount of duct friction head. Since it was not possible to evaluate this duct friction head under actual conditions of test, a separate test of a straight pipe section was made. The *net* junction losses were obtained by subtracting this nominal pipe friction from the total head, and were then expressed in terms of the velocity head.

That is,

$$\lambda_u = \frac{(TP_1 - TP_2) - SP_f}{VP_u}$$

in which,

λ_u = the coefficient of loss

TP_1 = total pressure measured in the trunk duct upstream of the take-off fitting, in. of water

TP_2 = total pressure measured in the branch duct downstream of the take-off fitting, in. of water

SP_f = the static loss due to friction in the trunk and branch ducts between the measuring stations and the fitting, in. of water

VP_u = the velocity pressure in the trunk duct, in. of water

The evaluation of the nominal pipe friction of a straight pipe has no actual significance, but is of importance in practical applications of the results, since the computation of the friction losses for the entire duct system can then be made by adding the losses for the component parts of the entire duct system.

The results obtained by Thoma indicated that the junction losses, λ_u, thus obtained were functions only of the ratio, Q_b/Q_u, in which Q_b and Q_u represented the flow volumes in the branch pipe and united flow in the trunk, respectively. Apparently, the junction losses were not dependent upon the mass rate of flow; in other words, the losses were independent of Reynolds Number, N_{Re}. The test results reported in references 7 and 10 have been replotted as shown in Fig. 2 to show the junction loss, λ_b, expressed in terms of the velocity head in the

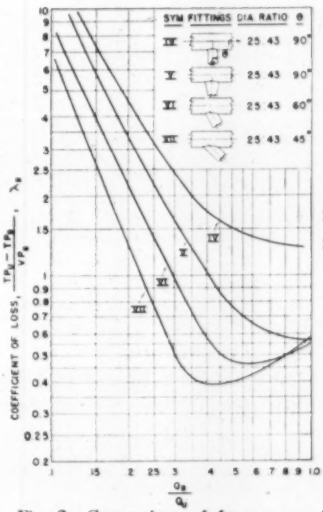

Fig. 2—Comparison of four types of fittings tested by Thoma and associates
(Data replotted from references 7, 9, 10)

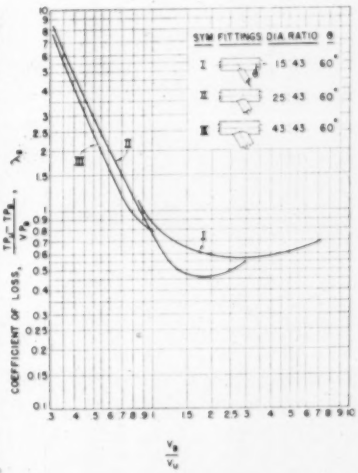

Fig. 3—Area ratio effect on coefficient of loss when plotted against velocity ratio
(Data replotted from reference 10)

branch pipe. The curves show not only the comparative effects of angle branching and right-angled tees, but also that the junction loss, λ_b, is proportionately greater for smaller diversions of the flow into the branch pipe than for large diversions. As anticipated, angle branching appears to be an effective method for reducing junction losses. In addition, the use of a conical intake is effective in reducing the losses of a right-angled junction, especially for higher ratios of Q_b/Q_u.

The curves in Fig. 2 were all for a ratio of branch diameter to trunk diameter, d_b/d_u, of 25/43. If the test results for different diameter ratios had been plotted on the same figure, a separate and distinct curve would be obtained for each diameter ratio. However, as suggested by Brabbee[12] and Vazsonyi,[8] by plotting the coefficient of loss against the independent variable of V_b/V_u instead of Q_b/Q_u, it should be possible to present the results obtained with different diameter ratios by a single curve. This has been done by replotting the loss coefficients obtained by Kinne[10] for a 60-deg angle branch having diameter ratios of 15/43, 25/43, and 43/43. As shown in Fig. 3, the agreement is fair since the separate curves do not deviate too far from each other. Additional tests of other types of junctions would be desirable to establish the fact that a single curve would represent results for a wide range of diameter ratios.

Another investigation of junction losses was made in connection with model tests of penstocks for the Boulder Dam project.[13] Since the magnitude of N_{Re} for the Thoma tests was of the order of 100,000 while that for the prototype junctions of the Boulder Dam project was of the order of 90,000,000, tests were made with models for which the range of N_{Re} was between 130,000 and 800,000. Some special tests with a 90-deg junction were made in an attempt to duplicate the work of Vogel[7] under conditions of a larger scale and a higher N_{Re}, but the coefficients of loss were found to be considerably lower in magnitude. Another series of tests made with a slightly different junction showed, however, no influence of N_{Re}. If this is also true for the 90-deg junction, the discrepancy in the coefficients of loss between the Boulder Dam and the Vogel tests is difficult to explain. Hence, the rela-

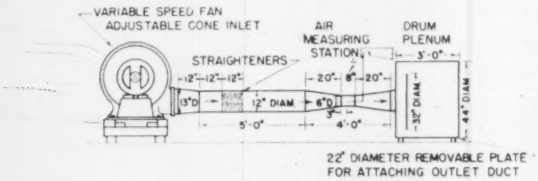

Fig. 4a—Test arrangement for measuring and delivering air

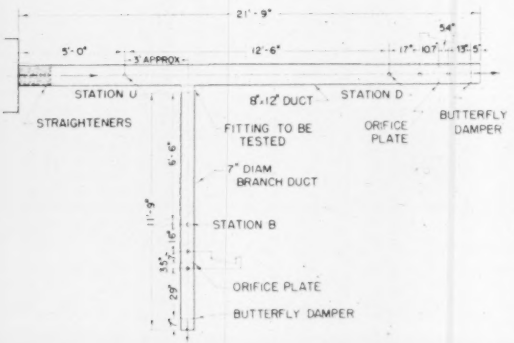

Fig. 4b—Test arrangement showing drum plenum, extended plenum trunk duct, and fitting

tionship between the coefficient of loss and N_{Re} cannot be considered as definitely established.

In the report of the Boulder Dam tests, an empirical equation of the following form was given as representing the measured losses of the junction:

$$\lambda_b = K + K_1 (V_s/V_b)^2$$

in which, K is a normal entrance-loss coefficient, and K_1 is an empirical constant.

The present writers were interested, however, in determining whether the application of the Borda-Carnot equation to the published data on pressure readings would yield results of any value. For this analysis the assumptions were made that: (*a*) the velocity across the vena contracta section was uniform, (*b*) the losses between the trunk duct and the vena contracta section were negligible, and (*c*) that the mixing loss downstream from the vena contracta section could be obtained from the Borda-Carnot equation. The results of this analysis were in substantial agreement with the experimental data, especially for higher ratios of Q_b/Q_s. This indicates in general that the mixing losses are a dominant part of the entire junction loss.

In general, the study of work by previous investigators indicated the necessity of actual tests of any new junction form, preferably with full scale equipment.

Description of Equipment

The arrangement for metering the air and for delivering the metered quantity of air to the test section is shown in Fig. 4*a* and has been described in a previous publication.[4]

In Fig. 4*b* the 12 in. × 8 in. extended plenum trunk duct is shown attached to the drum plenum, and the fitting to be tested was attached to either the top or side of the trunk duct approximately 8 ft. from the face of the drum plenum. Egg-crate straighteners installed in the 12 in. × 8 in. duct, at the point where the trunk was attached to the plenum, were for the purpose of eliminating the swirling motion of the air stream. Piezometer connectors were installed on the trunk duct 5 ft and 17½ ft from the face of the drum plenum and in the branch duct 6½ ft from the trunk duct. These piezometer connectors were fastened at the center of the top, bottom, and both sides of the ducts in the same vertical plane, and were then connected in parallel to give an average reading of pressures.

For measuring the air flow in the trunk duct downstream of the branch, an orifice with an open area of 50 percent, together with diameter taps, was installed in the trunk duct approximately 20 ft from the face of the drum plenum. Flow through the orifice was controlled by a butterfly damper installed at a sufficient distance downstream to avoid interference. A similar orifice and damper arrangement was installed in the branch duct.

The fittings tested were of three distinct types. The side take-off fitting placed over an opening in the side of the trunk duct, delivered air to a branch duct in the same horizontal plane as the trunk duct. A second type of side take-off fitting employed an expansion section inserted into the trunk duct with a second fitting to turn the air into the branch duct in the same horizontal plane. Top take-off fittings were placed over an opening in the top of the trunk duct and delivered air to a branch duct running perpendicular to the trunk duct but in a horizontal plane above the trunk duct.

Calibration of Equipment

For purposes of calibration the arrangement shown in Fig. 4*a* was used. Three ducts consisting of a 12 in. × 8 in. rectangular trunk duct, a 7 in. diameter round pipe, and a 5 in. × 8 in. duct were separately connected to the drum plenum shown in Fig. 4*a* for purposes of calibration. For all three duct arrangements, egg-crate straight-

eners and piezometer rings were installed. The upstream piezometer ring was located about five feet from the plenum, and the downstream piezometer ring was about 17½ ft from the plenum. A series of tests was conducted to compare the pressure readings of the piezometer rings with those obtained by means of a traversing static pressure tube. The pressure holes in this traversing tube were located in the plane of the piezometer ring. With a definite air quantity flowing in the duct, a twenty-point equal-area traverse was made with this tube located at both stations, and simultaneous readings were made with the piezometer ring. The separate pressure measurements obtained with these two devices were found to be in excellent agreement. Hence, in subsequent tests, the readings obtained by means of the piezometer ring were accepted as a true index of the static pressures at the two measuring stations.

For the purpose of determining the friction loss in the three separate test ducts, a series of tests was conducted, during which static pressures were observed at the two piezometer rings. The friction loss per 100 ft of straight duct could be evaluated for a given air quantity. The data obtained from these tests were compared with similar data reported by D. K. Wright, Jr.[1] In general, the Illinois data were in fair agreement with the Wright data, but since the former data were derived specifically for the ducts used in this investigation, they were selected for later use.

A sharp-edged orifice with radius taps was installed approximately 2 ft downstream from the second piezometer ring. The area ratio of duct to orifice was approximately 2 to 1. With this arrangement, calibration tests were conducted, during which the air quantities flowing at the air measuring station and the pressure differential across the orifice were simultaneously determined. From these tests, final calibration curves were established for the orifices installed in the three separate test ducts. These orifices provided a means in later tests of evaluating the separate air quantities flowing in the extended plenum and branch ducts.

Procedure

The procedure for testing all types of fittings was the same. With the fitting installed in the test arrangement shown in Fig. 4*b* the total air quantity flowing at the air measuring station upstream of the drum plenum was set at the desired quantity and held constant throughout the test. Then air quantities flowing in the trunk and branch duct, and static pressure readings at stations U, D, and B were observed. The quantity of air flowing through the branch duct was varied from zero to 100 percent of total flow by varying the setting of the butterfly dampers in the trunk and branch ducts. For each damper setting, a complete set of readings was recorded. For example, in the test for the butt take-off fitting with 555 cfm flowing in the system, and with both the damper in the trunk and the damper in the branch duct wide open, the air quantity flowing through the trunk duct was 415 cfm and through the branch duct 140 cfm. The static pressure readings at stations U, D, and B were 0.091, 0.100, and 0.062 in. of water, respectively.

Test Results

90-Deg Side Take-Off Fittings. The test results for 90-deg side take-off fittings are shown in Fig. 5. Following the usual procedure the coefficient of loss, λ_b, is presented as a function of the quantity ratio, $\frac{Q_b}{Q_u}$. The coefficient of loss is herein defined as:

$$\lambda_b = \frac{TP_u - TP_b}{VP_b}$$

in which,

λ_b = the coefficient of loss in branch velocity heads

TP_u = the total pressure at station U, in. of water

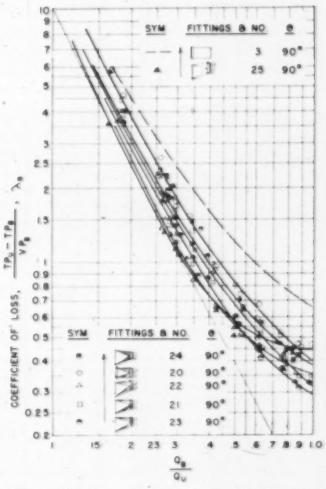

Fig. 5—Loss curves for 90-deg side take-off fittings

TP_b = the total pressure at station B, in. of water

VP_b = the velocity pressure at station B, in. of water

Q_u = the air quantity flowing at station U, cfm

Q_b = the air quantity flowing at station B, cfm

Fitting 3, which is a butt take-off, is comparable to that used in determining curve IV of Fig. 2. It may be noted from Fig. 5 that fitting 3 gave relatively high coefficients of loss. In attempting to improve on this butt take-off connection, a number of modifications were tested of which fittings 23, 24, and 25 demonstrate the major elements that affect the coefficient of loss. These three fittings had a 12 in. × 7 in. inlet opening and a 7 in. round outlet and were installed with the 12 in. dimension along the trunk duct. The center lines for the branch duct and trunk duct were in the same horizontal plane. However, the center of the 7 in. round outlet was shifted relative to the center of the 12 in. dimension of the inlet.

Fitting 24 approached a symmetrical design with the 7 in. round opening shifted 1 in. in the downstream direction. It is apparent

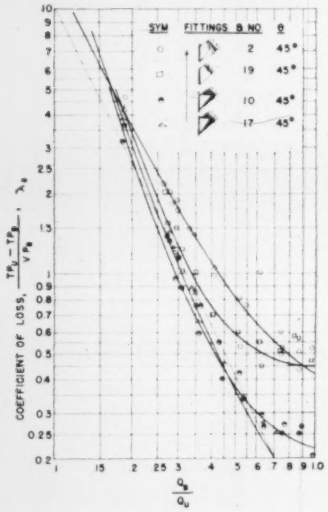

Fig. 6—Loss curves for 45-deg side take-off fittings

that the conical entry decreased the coefficient of loss over the complete range of quantity ratios.

In fitting 23, the 7 in. round opening was shifted 2½ in. in the downstream direction, thus reducing the sharpness of the turning angle at the upstream entrance of the fitting. A reduction in coefficient of loss for comparable quantity ratios was again obtained. This was attributed to the reduction in separation of flow from the walls following the upstream edge of the fitting.

A further shifting of the 7 in. round opening was tested in fitting 25 for which the round opening was shifted 4 in. in the downstream direction. For this arrangement a reduction in coefficient of loss was obtained for lower quantity ratios. However, for higher quantity ratios the coefficient of loss tended to approach a constant value, which was attributed to a second separation at the downstream edge of the inlet opening. For example, when all of the air was flowing out of the branch duct, ($Q_o/Q_n = 1.0$), it is probable that the direction of flow at the entrance of the fitting was nearly at right angles to the trunk duct wall, resulting in a second separation at the downstream edge of the inlet opening. Fittings 22, 23, and 25 gave the best results, indicating the desirability not only of using a conical entry, but also of reducing the sharpness of the turning angle at the entrance to the fitting. Although the coefficient of loss for fitting 25 at high ratios of Q_o/Q_n was larger than those for either fittings 23 or 24, the magnitude of the differences was negligible.

Angle Take-Off Fittings. Results obtained with angle take-off fittings are shown in Fig. 6. Fitting 19 is a 45-deg angle branch without conical entry, and the results are closely comparable to those shown by curve VII in Fig. 2. Improvement was again obtained for conical entry as shown by fittings 10 and 17.

Top Take-Off Fittings. Results obtained with top take-off fittings are shown in Fig. 7. Top take-off fittings necessitate two turns in two different planes, which tends to produce rotational flow. Rotational losses are extremely high when a contraction or separation of flow occurs. Fitting combination 3 and 4 which consisted of a butt take-off on the top of the trunk duct immediately followed by a 90-deg elbow gave poor results. Although rotation cannot be avoided when a top take-off fitting is used, separation can be reduced by measures similar to the conical entries used previously for side take-offs. Fittings 31 and 32, which incorporated both conical entry and reduction in sharpness of turning angle at the entry of the fitting, gave the best performance of those tested.

Reynolds Number Influence

Coefficient of loss λ_o has been presented in Figs. 5, 6, and 7 as depending only upon the quantity ratio Q_o/Q_n. This is true only if the Reynolds Number, N_{Re}, has no influence. As explained earlier, the findings of previous investigators[11] were not conclusive, and since the curves for coefficient of loss for this project were determined for total air volumes of 425 and 550 cfm corresponding to the Reynolds Numbers of 5.56×10^4 and 6.11×10^4, respectively, it was necessary to explore a wider range of Reynolds Numbers.

In this discussion, Reynolds Number is defined as:

$$N_{Re} = \frac{4mV\rho}{\mu}$$

in which

N_{Re} = the Reynolds Number for the trunk duct

m = hydraulic radius of the trunk duct, feet

V = the velocity in the trunk duct, feet per second

ρ = the density of the fluid, pounds per cubic foot

μ = absolute viscosity, pounds per foot-second

A special series of tests was conducted with fitting 25 for total air quantities ranging from 40 cfm to 600 cfm, corresponding to N_{Re} from 4.43×10^3 to 6.66×10^4, respectively. The results of these tests are plotted in Fig. 8. For a particular quantity ratio, the coefficient of loss is constant for large values of N_{Re}, but increases for small values of N_{Re}. Therefore, a limitation exists in the method of plotting used in Figs. 5,

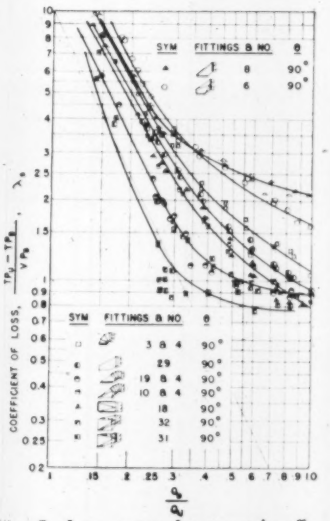

Fig. 7—Loss curves for top take-off fittings

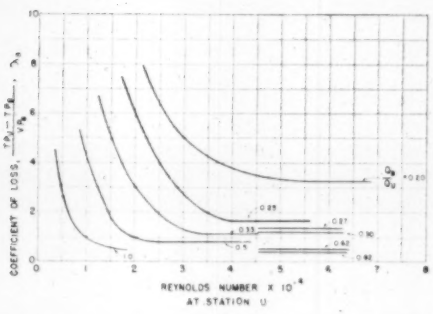

Fig. 8—Losses as related to Reynolds Number

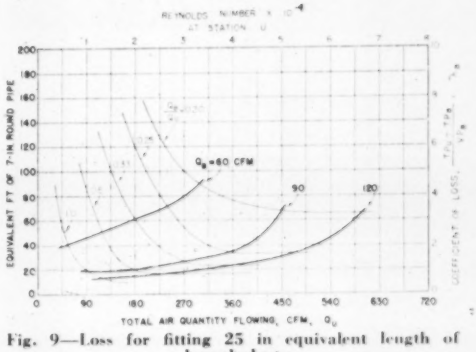

Fig. 9—Loss for fitting 25 in equivalent length of branch duct

6, and 7, in which the coefficient of loss is considered to be a function of the quantity ratio only. For very low values of N_{Re}, that is, for low total air quantities flowing, an increase in coefficient of loss can be expected, which in turn will reduce the applicability of the test data illustrated in Figs. 5, 6, and 7.

Therefore, the results shown in Figs. 5, 6, and 7 hold only for conditions in which N_{Re} has little or no influence, which limits the application of these test results.

Practical Interpretation of Test Results

For practical application, the methods of presenting results given in Figs. 5, 6, 7, and 8 were not convenient to use. A method of presenting these data in terms of actual air volumes rather than N_{Re}, and equivalent lengths rather than λ_b would be of more practical value. For this purpose the values for Fig. 8 were replotted as shown in Fig. 9. For the given system in which the trunk duct was 12 in. × 8 in. and the branch duct was a 7-in. round pipe, and the air properties were considered as remaining constant, it is possible to replace the N_{Re} in Fig. 8 by air quantities in cfm. Furthermore, with total air quantities established, it is possible to determine curves of constant branch quantity for the particular branch size. Finally, it was also possible to convert the coefficient of loss for a given fitting into terms of equivalent length of branch duct. In this conversion, the friction factor, f, was considered to be constant, which is equivalent to applying a constant conversion factor between the coefficient of loss and the equivalent length of branch duct.

The method of representing data which is shown in Fig. 9 is the most convenient for practical application, but would require a separate set of curves for each combination of branch and trunk duct to be used. However, this figure demonstrates that:

1. A constant value of equivalent length cannot be expected.

2. The take-off nearest the conditioner will have the largest equivalent length, as compared to a second, third, or other branch, when equal conditions of branch size and air delivery are maintained.

Equivalent length values were established for four representative fittings tested and were plotted in Fig. 10. As mentioned previously, these equivalent lengths apply directly only for the arrangement given and in the region where the fittings loss is independent of N_{Re}.

Comparison With Previous Results

The fittings used in this investigation were not geometrically similar to those used by previous investigators, so that a direct comparison of results was not possible. However, fitting 19 corresponded closely to the 45-deg branching angle tested by Petermann.[5] In the latter tests, water flowed through a 43 mm trunk and a 25 mm branch pipe. Petermann also conducted tests with ratios of branch diameter to trunk diameter of 15/43 and 43/43. These data are shown in Fig. 11 and are represented by solid lines. In addition, a curve for coefficient of loss is shown for fitting 19, for which the branch diameter was 7 in. and the equivalent diameter of the 12 in. × 8 in. trunk, based upon equal areas, was 11.05 in. In terms of the diameter ratios used by the previous investigators, this fitting corresponded to a ratio of 27.25/43, and the results obtained are shown in Fig. 11 by a broken line. It may be noted that the location of the curve for fitting 19 was fairly consistent with respect to the others, considered on the basis of the variation in diameter ratios.

A further analysis was made of the results of these three separate projects, by plotting the coefficient of loss against V_b/V_u, as was previously discussed in connection with Fig. 3. The losses for the four separate fittings having different area ratios could be represented by a single curve. This indicated that for a given type of fitting, a wide variation in the ratio of cross-sectional areas of branch and trunk duct would yield results which can be represented by a single curve based on a V_b/V_u scale. Furthermore, if a similar relation holds true for other types of fittings, then

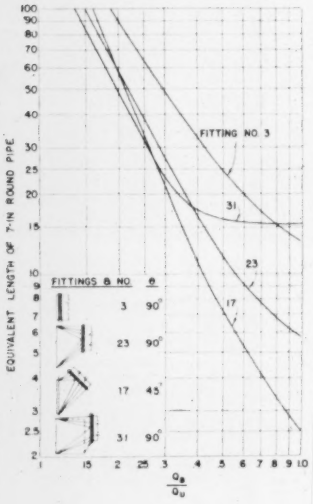

Fig. 10—Loss of fittings expressed in terms of equivalent lengths of branch duct

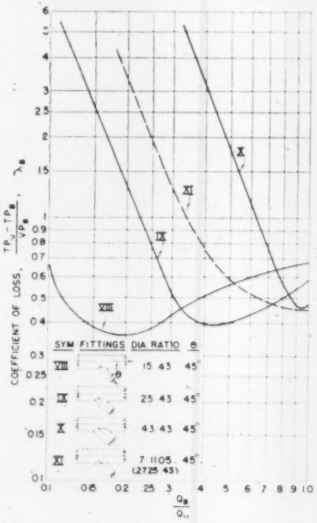

Fig. 11—Comparison of data from Illinois and Munich
(Munich data replotted from reference 9)

a family of curves similar to those shown in Fig. 11 can be established for each fitting. Tests could then be made of a particular combination of branch fitting and trunk duct, and the results extrapolated to any other combination of sizes of branch and trunk ducts. Additional tests to confirm this conclusion would be desirable.

Conclusions

Under the conditions maintained in these tests the following conclusions were made:

1. The results of this investigation were in substantial agreement with those of previous investigators.

2. Butt take-off fittings connecting a branch pipe to an extended plenum gave relatively high coefficients of loss for both side and top take-offs.

3. Conical entry decreases loss through both angle branches and 90-deg take-off fittings.

4. Reduction in sharpness of the turning angle at the entry of a fitting decreases loss through the fitting.

5. For large values of Reynolds Number, i.e., for large air quantities flowing the coefficient of loss is practically constant; however, for very low values of Reynolds Number an increase in coefficient of loss can be expected.

6. A constant value of equivalent length cannot be designated for a particular fitting, but depends upon the quantity ratio, and to some extent upon the total air quantities.

Acknowledgment

This paper is a report of an investigation conducted under the terms of a cooperative agreement between the *National Warm Air Heating and Air Conditioning Association* and the Engineering Experiment Station at the University of Illinois in the Mechanical Engineering Laboratory. The results presented in this paper will be ultimately included in a bulletin of the Engineering Experiment Station. Acknowledgment is made to the Research Advisory Committee of the Association for advice and counsel received.

This paper includes material from two theses completed under the direction of Prof. S. Konzo and submitted in partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering, by E. R. Zieve in 1947 and J. J. Boland also in 1947.

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11. Model Studies of Penstocks and Outlet Works (*United States Department of the Interior, Bureau of Reclamation, Boulder Canyon Project Final Reports*, Part II—Hydraulic Investigations, Bulletin 2, 1938.)

12. Reibungs-und Einzelwiderstände in Warmwasserheizungen, by C. W. Brabbee. (*Mitteilungen der Prüfungsanstalt für Heizung und Lüftung*, Heft, 5, Oldenbourg, Berlin, 1913.)

13. ASHVE RESEARCH REPORT No. 1280—A New Friction Chart for Round Ducts, by D. K. Wright, Jr. (ASHVE TRANSACTIONS, Vol. 51, 1945.)

1949 Annual Report of Committee on Research

L. N. Hunter, Chairman

L. N. Hunter, *Chairman*
Committee on Research

COMMITTEE ON RESEARCH

L. N. Hunter, *Chairman*; John James, *Vice Chairman*; Cyril Tasker, *Director of Research*; A. C. Fieldner, *Ex-Officio*.

Executive Committee: L. H. Hunter, *Chairman*; John James, *Vice Chairman*; A. B. Algren, R. C. Cross, R. D. Madison.

Three Years: I. W. Cotton, Nathaniel Glickman, W. A. Grant, L. N. Hunter, R. D. Madison.

Two Years: A. B. Algren, C. W. Johnson, E. R. Queer, W. E. Zieber.

One Year: R. C. Cross, M. K. Fahnestock, John James, F. J. Kurth, T. H. Urdahl.

John James, *Vice-Chairman*
Committee on Research

THE Committee on Research feels that this past year has been a successful one as far as Society research is concerned, but that this success is due partly to the cooperation and advice which it has received from several sources. The Council and officers of the Society have given the Committee splendid cooperation and have been very helpful in offering valuable suggestions from time to time, and we wish to express our appreciation for the same.

Finances

We refer you to the auditor's report and the Society's financial statement for information on Research finances.

The Committee wishes to acknowledge the splendid financial support received from industry during this past year. In 1949 there were 240 organizations which participated financially in our research program. C. A. McKeeman, formerly assistant to the president, who spent most of his time stimulating industry's interest and desire to participate in our research work, resigned last August. Since then, the Committee on Promotion of Research, under the chairmanship of J. E. Haines, has been carrying on with the fund raising responsibilities with the assistance of George Aubrey Hastings, the Society's public relations counsel, and Cyril Tasker, director of research.

We have no reason to feel that industry will not support our work in the future more extensively than in the past, if kept fully informed on our programs and our objectives.

Committee Activities

The Committee on Research held four meetings during the year and the Research Executive Committee held three. One of the things that is characteristic of the Committee on Research meetings is the excellent attendance record of the committee members and the seriousness with which they assume their responsibilities. The chairman wishes to thank all of the committee members for the fine cooperation received during the year.

We now have 19 different Technical Advisory Committees, which have a total membership of 256 persons. These Committees held 33 meetings during the year. The total number attending these meetings was 265 members and 206 guests, including members of the Laboratory Staff.

The Committee on Research wishes to express its appreciation to all of the TA Committee members, and especially to the Chairmen for their support and valuable contributions, advice and time which they have so freely given. The TA Committees have many responsibilities and we cannot emphasize too strongly the importance of their work.

Budget for 1950

The Research Committee submitted to Council several months ago a budget for the ensuing year, and at the October 17 meeting, Council approved a budget of $206,250 for 1950 research operations. Of this amount, $37,500 is for the project involving the Study of Human Calorimetry for the Navy, and the balance, $168,750, is for other Laboratory projects and cooperative research contracts.

Laboratory Staff

The Committee on Research wishes to acknowledge the excellent cooperation of the Laboratory staff under the able direction of Cyril Tasker, director of research. The interest shown by each staff member in his work and the teamwork that has been demonstrated by the staff as a whole have been very gratifying. The Committee recommended the reappointment of Mr. Tasker as director of research for the ensuing year, which recommendation has been approved by Council.

Publications and Papers

All research results are eventually made available to our members in published form, and in papers presented before the Society. They are published in the ASHVE JOURNAL and TRANSACTIONS. Where it seems advisable to do so, they are also published in the form of research bulletins.

Professional societies as a rule have difficulty in establishing a publication policy that suits everyone, and this Society is no exception. The results of our membership survey a year ago clearly indicated that many of our members would like to have the results of research presented in a more easily readable form and in such a way that they can be readily used for practical application. The Committee on Research has the responsibility of seeing that research results are pre-

RESEARCH PAPERS—1949

1. Necessity of Using a Directional Mean Radiant Temperature to Describe the Thermal Conditions in Rooms, by Vagn Korsgaard (Copenhagen S., Denmark) (June 1949, JOURNAL SECTION).

2. A New Radiometer Measuring Directional Mean Radiant Temperatures, by Vagn Korsgaard (Copenhagen S., Denmark) (July 1949, JOURNAL SECTION).

3. Air Streams from Perforated Panels, by Alfred Koestel, Philip Hermann, and G. L. Tuve (Cleveland, Ohio) (July 1949, JOURNAL SECTION).

4. Solar Energy Transmittance of Eight-Inch Hollow Glass Block, by George V. Parmelee and Warren W. Aubele (Cleveland, Ohio) (September 1949, JOURNAL SECTION).

5. Physiologic Examination of the Effective Temperature Index, by Nathaniel Glickman, Tohru Inouye, Robert W. Keeton, M.D. (Chicago, Ill.) and Maurice K. Fahnestock (Urbana, Ill.) (January 1950, JOURNAL SECTION).

6. Resistance Gradients Through Viscous Coated Air Filters, by Frank B. Rowley and Richard C. Jordan (Minneapolis, Minn.) (December 1949, JOURNAL SECTION).

7. A Simple Heated Thermocouple Anemometer, by Herbert B. Nottage (Cleveland, Ohio).

Presented at the 56th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Dallas, Tex., January 1950

TECHNICAL ADVISORY COMMITTEES

Air Cleaning: R. S. Dill, *Chairman;* I. W. Cotton*, R. B. Crepps, L. L. Dollinger, Jr., O. C. Ellason, R. S. Farr, C. D. Graham, A. B. Hubbard, K. W. MacKenzie, R. H. Mills, Arthur Nutting, G. W. Penney, C. B. Rowe, R. P. Warren, R. D. Wood.

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Cooling Load: W. E. Zieber*, *Chairman;* R. D. Blum, W. F. Friend, R. H. Heilman, H. W. Heisterkamp, R. C. Jordan, C. F. Kayan, J. N. Livermore, R. H. Lock, C. O. Mackey, J. P. Stewart.

Corrosion: L. F. Collins, *Chairman;* A. S. Gates, Jr., A. E. Griffin, E. W. Guernsey, H. A. Pray, F. N. Speller, T. H. Urdahl*.

Heat Flow Through Glass: R. A. Miller, *Chairman;* A. B. Algren*, W. J. Arner, A. H. Baker, F. L. Bishop, Jr., R. D. Blum, G. W. Day, J. E. Frazier, J. S. Herbert, E. H. Hobbie, C. O. Mackey, F. W. Preston, W. C. Randall, C. A. Richardson, Vic Sanders, H. B. Vincent.

Heat Pump: R. C. Jordan, *Chairman;* E. R. Ambrose, R. D. Blum, C. F. Boester, C. W. Brown, W. F. Friend, C. F. Kayan, E. N. Kemler, J. D. Kroeker, E. P. Palmatier, S. S. Sanford, W. E. Zieber*.

Heating Load: T. F. Rockwell, *Chairman;* R. A. Biggs, A. I. Brown, R. C. Cross*, R. S. Dill, W. S. Harris, J. M. Hartman, L. G. Miller, S. I. Rottmayer, M. W. Shears, G. H. Tuttle.

Human Calorimetry: G. L. Tuve, *Chairman;* E. F. DuBois, M.D., J. D. Hardy, M.D., E. R. Queer*, L. E. Seeley, C. P. Yaglou.

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Insulation: E. R. Queer*, *Chairman;* R. E. Backstrom, C. B. Bradley, R. B. Crepps, M. W. Keyes, H. E. Lewis, H. E. Robinson, Vic Sanders, T. D. Stafford, L. V. Teesdale, R. K. Thulman, T. T. Tucker, P. M. Woodworth.

Odors: T. H. Urdahl*, *Chairman;* N. E. Berry, W. V. Consolazio, C. L. Fay, W. A. Grant*, E. P. Heckel, G. W. Meek, Amos Turk, W. N. Witheridge.

Panel Heating and Cooling: P. B. Gordon, *Chairman;* A. B. Algren*, J. W. James*, J. S. Locke, S. K. Smith.

Group A—Heat Distribution Within and Behind the Panel: A. B. Algren*, *Chairman;* C. E. Abbey, R. A. Biggs, R. S. Dill, H. L. Flodin, F. E. Giesecke, W. S. Harris, C. F. Kayan, G. D. Lain, R. L. Maher, C. W. Meininger, D. L. Mills, C. W. Nessell, P. S. Park, S. I. Rottmayer, E. E. Scott, S. K. Smith, R. K. Thulman, S. M. VanKirk, W. J. Widmer, G. L. Wiggs.

Group B—Heat Transfer Between the Panel and the Space: J. W. James*, *Chairman;* H. F. Randolph, *Vice Chairman;* C. M. Ashley, J. T. Bergen, C. F. Boester, Wharton Clay, Linn Helander, A. L. Jaros, Jr., H. A. Lockhart, W. E. Long, C. O. Mackey, R. A. Miller, G. W. Penney, G. G. Sward, J. M. van Nieukerken, H. E. Wheeler.

Group D—Controls: J. S. Locke, *Chairman;* H. W. Alyea, S. D. Browne, R. L. Campbell, C. M. Garner, P. B. Gordon, W. J. Hajek, A. J. Keating, W. H. Kliever, H. T. Kucera, P. F. Neess, J. K. M. Pryke, E. J. Ritchie, C. W. Signor, N. D. Skinner, A. S. Widdowfield.

Physiological Research: R. W. Keeton, M.D., *Chairman;* Thomas Bedford, A. R. Behnke, Capt., MC, USN, E. W. Brown, M.D., A. C. Burton, M.D., E. F. DuBois, M.D., A. P. Gagge, Lt. Col., MSC, USAF, F. K. Hick, M.D., J. W. James*, D. H. K. Lee, M.D., Charles Sheard, C. L. Taylor, C.-E. A. Winslow.

Sensations of Comfort: C. S. Leopold, *Chairman;* Lester T. Avery, John Everetts, Jr., Nathaniel Glickman, W. A. Grant*, A. J. Hess, E. J. Rodee.

Sorbents: John Everetts, Jr., *Chairman;* G. C. F. Asker, I. W. Cotton*, F. C. Dehler, A. S. Gates, Jr., E. W. Gifford, E. R. McLaughlin, J. C. Patterson, G. L. Simpson, F. J. Swaney.

Sound Control: T. A. Walters, *Chairman;* C. M. Ashley, John Cassie, P. H. Geiger, Sidney Gordon, H. C. Hardy, F. B. Holgate, G. C. Kerr, M. W. Keyes, R. D. Madison*, T. H. Troller, George Wohlberg.

*Member of Committee on Research

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sented in a complete and scientific form in order that they be made available for future reference.

The application engineer is usually interested only in the final results expressed in a readily usable and condensed form. There is a question, however, as to whether preparation of the results in this form should be the function of the Committee on Research or of some other part of our Society's organization. THE GUIDE serves this purpose, but, of course, there is a period of time which elapses between the original publication of the results and the publication of THE GUIDE.

Research Policy

The Committee on Research has to work within the scope of the rules and regulations which have been laid down for it by the Society. However, within the scope of these rules and regulations there are many policies and interpretations that have to be decided. In order to maintain a consistent research policy, a Research Policy Subcommittee of the Research Committee has been formed, under the chairmanship of Prof. E. R. Queer, to study policy matters and make recommendations on the same to the Committee on Research for adoption.

The Committee on Research has been considering for some time ways of encouraging more of our members to participate in the planning of our research work. Because many of our Society members who are not on TA Committees have shown an interest in the work of those committees, we tried an experiment at the 1949 Annual Meeting in Chicago, and Society members were given an opportunity to attend the meetings of the TA Committees, whether they were members of the TA Committees or not. Previously, attendance was limited to Committee members and invited guests only. Many of our members took advantage of this opportunity and the reaction was so favorable that the same policy has been adopted regarding attendance at the TA Committee meetings held during the 1950 Annual Meeting. Consideration will be given to making this policy a permanent one.

Research Program

We did not spend quite as much money in 1949 as we expected we would, mainly for two reasons.

Although real progress has been made by the Laboratory Staff in the work involving the study of Human Calorimetry, we spent about $30,000 less on this project than we expected to. This was largely because it was found that much less expensive equipment could be used in carrying on this research work than was originally anticipated. This program is financed by the Office of Naval Research.

As most of you know, the business outlook last winter and early last spring was quite uncertain and it was felt advisable, therefore, to defer temporarily the expenditure of money for building two psychrometric rooms. However, we are definitely going ahead with these. Part of the research work for these rooms is on behalf of the studies for the TAC on Panel Heating and Cooling and part for the program proposed by the TAC on Sensations of Comfort. This is a new Committee appointed this year under the chairmanship of C. S. Leopold, and the scope of its activities will cover, primarily, studies of sensory reactions to environmental conditions at or near the optimum.

The Committee on Research continues to encourage projects with cooperating institutions. Contracts were completed with a number of them in 1949, and other proposals have been received and are under consideration. There is frequently quite a bit of work involved in setting up a cooperative project, and

sometimes the progress may seem slow. Negotiations between the prospective cooperating institution and the Laboratory must be completed to a point where there is sufficient information available to permit the project to be referred to the proper TA Committee, so they may review it and advise the Committee on Research on what action should be taken on the proposal. The easiest kind of project to set up is one where the cooperating institution has the necessary facilities and qualified personnel to undertake a specific project in which the Society is particularly interested. Occasionally, however, an institution will write to the Society advising that they want to do some research work and ask us to assign them a problem and the necessary funds. It is difficult to do this if you do not know the personnel and the facilities that are available at the institution and, consequently, negotiations are sometimes extended over a greater period of time than normally would be the case.

One year ago the Committee on Research made a survey of our membership to determine the attitude and feelings of the Society membership toward our research program and its objectives. It was hoped that the results would serve as a valuable guide in formulating future research programs. The results of this survey were presented to the Society at the 1949 Semi-Annual Meeting, and were published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, August 1949, p. 123. The results indicated that the current research program was pretty much in line with the thinking of our membership, but that more emphasis should be placed on the heat pump and on odors. Consequently, the TA Committee on Heat Pump has been quite active during this past year. One cooperative research project on this subject has been approved and others are under consideration.

The TAC on Odors has been quite active, and is giving consideration to this very complex problem and it is expected that a research program on odors will soon be under way. The scope of this committee involves the study of odor problems, including the formation, methods of measurement, and control of odors, and the physiological reactions to them.

The report of the director of research, which follows, will summarize for you the past year's work at the Laboratory and cooperating institutions and the activities of the TA Committees.

Report of The Director of Research

By Cyril Tasker

Steady progress was made in 1949 in most of the major projects on the Society's research program, although the uncertain business conditions in the first half of the year made it seem advisable to defer the initiation of one or two important projects, and to reduce the rate of expenditure on others, until after midsummer.

Among major Laboratory projects were those concerned with heat gain through sunlit building surfaces; panel heating; certain parts of the overall problem of air flow and air distribution in rooms; air cleaning; and the combustion characteristics of fuel oils. At the eight institutions cooperating with the Committee on Research, investigations were under way on physiological reactions to atmospheric environment; air flow and air distribution; certain phases of the problem of cooling loads; and some parts of the research program in panel heating. Under a contract with the Office of Naval Research the Laboratory gave continuous attention to the problem of designing and constructing a calorimeter for the study of heat exchange between the human body and its surroundings. More details of these projects are given later, grouped under a number of general headings.

Staff

Though there were no important changes in the Laboratory's engineering staff during 1949, the number and the variety of problems under investigation showed once more how important it is in any research organization to develop the team spirit and use the combined

Cyril Tasker

skills and ideas of the team in the preliminary phases of any investigation and from time to time as the work proceeds. At the year end the full-time staff numbered 24, of whom 12 were graduate scientific staff. Part-time clerical and technical staff, and the consulting services of members of the faculty of Case Institute of Technology, were also used during the year as needed.

Following the resignation in mid-August of C. A. McKeeman, assistant to the president, the director of research undertook certain of his duties, chiefly those concerned with maintaining contact with industrial organizations and trade associations who are interested in, and have given support to, the Society's research program.

Equipment

Additional office equipment was secured and display and storage space provided in the library for current magazines. Important additions were made to the library and several major items of laboratory equipment were added to a growing inventory of scientific apparatus available for laboratory or field projects.

Property Maintenance and Improvement

A number of important improvements were made to the property in 1949. Additional office space was provided from hitherto little-used space and insulation added where needed. Fire-resistant storage space was provided in the laboratory building for important laboratory papers, original data and records. Asphalt tile floors were laid in five rooms; the entire office building now has this type of flooring and can be maintained in good condition with modern-type equipment purchased during the year. Old-type lighting fixtures were replaced with fluorescent fixtures. All interior surfaces in the office building and in the laboratory were cleaned or painted during the year. The exterior of the frame office building was painted late in the summer; the parking area at the rear of the laboratory was enlarged and improved.

Accounting

During 1949 all research expenditures were made from Cleveland and all accounting carried on there. Income was handled, as required by the Constitution, through the Treasurer's Account in New York. This system has worked with the utmost satisfaction and has made it possible to provide the Committee on Research and the Finance

JOURNAL SECTION

INSTITUTIONS COOPERATING WITH THE COMMITTEE ON RESEARCH

Case Institute of Technology, Cleveland, Ohio: Air Distribution from Jets, Slots, Perforated Panels, and other Forms of Outlets.

Columbia University, New York, N. Y.: Investigation by Electrical Analogy Methods of the Effect of Idle Pipes on the Temperature Field and Heat Flow in a Concrete Panel.

Cornell University, Ithaca, N. Y.: The Effects of Size and other Characteristics of the Sol-Air Thermometer on Measurements of Sol-Air Temperature.

University of Illinois, College of Medicine, Chicago, Ill.: Studies of the Physiological Adjustments made by Healthy and Physically Impaired Persons to Sudden Changes in Atmospheric Environment.

Kansas State College, Manhattan, Kans.: Investigation of Heated Air Streams projected vertically downward. Subjective Reactions to Panel Heating at Various Operative Temperatures.

Michigan State College, East Lansing, Mich.: Studies of Friction in Branch Take-Off Fittings in Rectangular Ducts.

University of Minnesota, Minneapolis, Minn.: Solar Energy as a Potential Heat Source for Heat Pump Installations.

Tulane University, New Orleans, La.: Development of Sol-Air Temperature Data for New Orleans.

Committee at any time with accurate and up-to-date figures, not only on total income and expenditures but with detailed expenditures on each project on the program.

Studies at Cleveland Laboratory and Cooperating Institutions

In an annual report only brief attention can be drawn to some of the main accomplishments in so extensive and varied a program. Minutes of each committee meeting as well as progress reports are provided at fairly regular intervals for the members of each technical advisory committee and all members of the Committee on Research. Research bulletins, or research papers prepared for presentation at regular meetings of the Society, form permanent records of the studies carried on under the direction of the Committee on Research. Visits from members of the Society and others interested in the program are important to the work of the Laboratory; such contacts are valuable as they serve to keep the staff in touch with some of the day-to-day problems of the industry it strives to serve. The major projects are outlined in the following paragraphs:

Air Flow and Distribution

To realize more effectively its long-range objective of establishing reliable fundamental data at the same time as it investigates important practical problems, studies under the Technical Advisory Committee on Air Distribution were divided by the committee into three main groups, dealing respectively with air flow in ducts and fittings, room air distribution, and field practices. Two outline charts, one on duct flow and one on room air distribution, which were first prepared in 1946, were revised in order to classify design data and application problems in the light of present knowledge.

Air Flow in Ducts and Fittings

At Michigan State College, under Dean L. G. Miller, studies are under way on the resistance to the flow of air offered by take-offs from a rectangular main to rectangular branches involving a 90-deg turn. Three types of take-offs are being studied: (*a*) Where main expands, in width only, to include total width of branch and continuation of main, and branch includes a standard 90-deg ell; (*b*) Main is decreased in width to that of continuing main while branch is taken off from sloping side of decreaser with a fitting and a 45-deg angle; and (*c*) The so-called *tailor-made* fitting where the 90-deg ell is built into main.

At the Laboratory a survey is under way of available information on losses in through-flow duct bends. A bibliography of over 150 references has so far been compiled; the most important of these are being carefully studied. By following this procedure it is hoped that a sufficient amount of data can be compared on a common basis to reduce the confusion caused by the wide variations in test results from various investigators. The survey is designed to point out those factors which require additional experimental investigation.

Room Air Distribution

Studies have continued at the Laboratory, at Case Institute of Technology and at Kansas State College.

At the Laboratory a very comprehensive survey and critical analysis of available information on the fundamentals of ventilation jet behavior have been completed and are being prepared for publication. Experimental studies on jets discharging horizontally into a large free space are under way, initially using a 6-in. round nozzle. Jet outlet temperatures ranging from 50 deg below the surrounding temperature to 80 deg above can be provided with velocities ranging from 100 fpm to 6000 fpm. Turbulence can be varied over a wide range. The present studies with chilled jets are covering a region where no good data exist at present.

Most studies of air distribution depend greatly on the ability to measure low air velocities with reasonable accuracy and rapidity. Since suitable commercial instruments were not available the Laboratory undertook the development and construction of a heated-thermocouple anemometer capable of giving reproducible results within the range required. A paper was prepared on this work and submitted for publication. It is hoped that its presentation will stimulate the interest of others in the problem of measuring low air velocities.

Case Institute of Technology—Under the direction of Prof. G. L. Tuve numerous tests have been made to determine the extent of similarity in the behavior of air streams projected from a free opening, a grille or register of the commercial type with a percentage free area ranging from 55 to 85, and a perforated panel with a free opening ranging from 3 to 15 percent. It is believed that they may behave in a similar manner after the jet coalescence has been taken into account. It is also thought that flow data on all types of outlets can be correlated to the extent that the approximate throw and spread of the stream can be predicted by the same method for all devices. However, it is evident, Prof. Tuve reports, that there are still unknown factors calling for further research.

Studies with slotted type outlets are continuing. A paper[1] on this subject was presented at the 1949 Semi-Annual Meeting in Minneapolis.

Kansas State College—Studies of downwardly projected warm air streams are being made under the direction of Prof. Linn Helander and with the active support of the *Industrial Unit Heater Association*. Experimental work was extended to cover temperatures and velocities along the vertical axis of streams projected from 2-in. and 4-in. diameter nozzles. Additional mathematical analysis has resulted in formulas for the maximum downward blow of other types of idealized streams than that reported in an earlier paper.[2]

With the cooperation of members of *IUHA* in the loan of equipment and provision of additional funds, test equipment has now been installed at Manhattan that will permit the study of streams projected downward from orifices between 6-in. and 20-in. in diameter and from heights up to 35 ft. Studies with ambient air and heated air are planned for the early part of 1950.

Physiological Research

Human Calorimetry (O.N.R. Contract)

In the 1948 report brief mention was made of the scope of the investigation

[1] Air Streams from Perforated Panels, by Alfred Koestel, Philip Hermann and G. L. Tuve. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1949, p.107.)

[2] Downward Projection of Heated Air, by Linn Helander and C. V. Jakowatz. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, March 1948.)

under way under a contract with the Office of Naval Research and with the cooperation of the *Naval Medical Research Institute*. The special advisory committee met twice in the early months of 1949 and established the design criteria for the calorimeter and the auxiliary equipment. Perhaps the most important decision was that the calorimeter shell, first pictured as an end-opening submerged cylinder, should be redesigned as a double-walled rectangular compartment 32-in. square in cross section by 84-in. long. Openings were provided for respiratory and ventilatory air ducts and for the visual observation of the subject. Following approval of the final design an order was placed for the fabrication of the shell and, but for a rather lengthy strike at the fabricator's plant, the shell would have been delivered before the year's end. Some auxiliary equipment has already been delivered and assembly will proceed rapidly on receipt of the shell.

The special heat metering layer, originally suggested by Dr. T. H. Benzinger, was found to require additional development before it could be applied satisfactorily to large areas. This development was completed in October and accelerated-use test procedures completed in November. All the layer sections for the calorimeter shell are now complete and ready for installation. Special equipment to provide the necessary bonding temperature is under construction.

One of the most difficult problems facing the Laboratory staff has been to design the fluid flow circuits in such a way as to give the required flexibility and still retain the very close temperature control suggested as essential to the operation of the calorimeter. Though this problem has not yet been finally solved substantial progress has been made.

The satisfactory operation of the ventilatory air circuit depends almost entirely on the design and construction of socalled *plate meters*. To obtain performance data a pilot plate meter unit was constructed and subjected to a long series of tests from which data were secured for use in the final design now awaiting approval.

The original contract, of two-year duration, will expire in mid-1950. Late in the year an application was made to the Navy Department for extension of this contract to mid-1952. As reported previously, all operating costs on this project are covered from funds made available by the Office of Naval Research.

Environmental Effects

Studies at the College of Medicine, University of Illinois, on the physiological adjustments of healthy and physically impaired persons to sudden changes in environment were continued throughout the year. During 1949 financial support of these studies was augmented by means of a grant-in-aid of the National Institutes of Health, U. S. Public Health Service, and by funds provided by the Association of American Railroads.

A paper[3] on the subject of the effective temperature index, prepared for presentation at the 56th Annual Meeting, reported the results obtained in a study designed to compare, by physiological measurements, the response of healthy subjects to two different ambient environments having the same effective temperature. Relative humidities of 30 percent and 80 percent and effective temperatures in the zones of body cooling, thermal neutrality, and evaporative regulation were selected. Studies were made with the subjects in approximate equilibrium with the environment. The results suggest, it is believed, that the present ET index is adequate for subjects in the transient state except that some correction is needed at the higher temperatures (ET's of 82 and above). For subjects in a steady-state it is suggested that the present ET index places too much emphasis on the influence of relative humidity for the range of ambient conditions studied, (dry bulb temperatures from 60 F to 97 F; ET's from 59½ to 82½ deg). These studies are continuing with grossly obese, lean and emaciated subjects and those with other physical impairments.

Considerable interest is being displayed in many parts of the world in questions of thermal comfort in temperate and tropical climates. The Society is cooperating in a rather extensive exchange of information between the various investigators in this field, some of whom are corresponding (foreign) members of the TAC on Physiological Research.

Under the sponsorship of the TAC on Sensations of Comfort important changes have been made on the Comfort Chart to be published in the HEATING, VENTILATING, AIR CONDITIONING GUIDE 1950 to reflect the fact that both laboratory research and field observations over the past several years indicate that the optimum dry bulb temperature for winter is about 75 F and that this seems to hold over a fairly wide range of relative humidities.

The calorimeter room now under construction at Cleveland will enable the Laboratory once again to engage directly in studies on sensory and physiological reactions of persons to environmental conditions.

Heat Flow and Heat Transfer

Studies on the effects of low velocity air movements on heat transfer from a smooth surface were completed; the results are being prepared for publication.

Heat Transmission Through Glass

The experimental work on glass block, mentioned in the 1948 Annual Report of the Committee on Research, was continued through June 1949, solar transmittance data being obtained for nine panels which included three sizes of block and six patterns. Tests were also made to determine the heat gain by convection and radiation from the indoor surface of the panel and to determine overall coefficients under steady-state natural weather conditions. A paper[4] was presented at the 1949 Semi-Annual Meeting. Further analysis is being made of heat flow by radiation and convection.

Experimental work on configurated glass was conducted between July and October; the results are now being prepared for presentation as a research paper.

The Eppley pyrheliometer has been used consistently during these investigations. Tests made during 1949 showed that the response of this instrument is 4 percent higher when it is horizontal than when it is in a vertical position.

In the 1948 report it was mentioned that a convection-compensated radiometer had been designed and constructed at the Laboratory to measure incoming radiation from all sources. During 1949 it was subjected to considerable development, testing and use. After wind tunnel tests it was mounted on the calorimeter, and has been used in all tests since then to measure the long wave length radiant energy received from the outdoor surroundings. A small blower was later added to produce a more constant convection effect. Calibrations carried out indoors with a standard black body indicated that the error of the instrument was of the order of 3 percent for the usual range of measurements. Tests with the instrument mounted on a vertical wall show that early and late in the day the outdoor surroundings, including the sky, contribute substantially less radiation than a black body radiating at air temperature. The magnitude of this difference is significant, and in tests made at the Laboratory amounted to 20 Btu per (hr) (sq ft). Near noon, due to solar heating, the surroundings emit nearly as much radiation as a black body would, radiating at air temperature.

Design Data on Heat Flow Through Glass

The true significance of the results of the extensive investigations made in the past three years on heat transmission through glass will not be realized until the experimental data are translated into design data and put into such a form that they may be readily used by design engineers and others interested in calculations of heat flow through sunlit building surfaces. Aided by the advice of a special subcommittee of the TAC on Cooling Load and TAC on Heat Flow Through Glass, the Laboratory staff have made marked progress in this phase of the program.

Design heat flow tables for selected solar and weather conditions for six patterns of 8-in. glass block have been prepared. Additions have been made to

[3] Physiologic Examination of the Effective Temperature Index, by Nathaniel Glickman Tohru Inouye, R. W. Keeton and M. K. Fahnestock. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, January 1950.)

[4] Solar Energy Transmittance of Eight-Inch Hollow Glass Block, by George V. Parmelee and Warren W. Aubele. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, September 1949.)

design data for flat glass. Tables have been prepared giving overall coefficients for flat glass and glass block, for stated design conditions. These data are being submitted for committee study prior to presentation as a research paper, as a preliminary to preparation for anticipated use in the THE GUIDE 1951. At present the staff are working on a graphical solution of the heat balance equations for heat flow through single and double flat glass so that design data may be set up for a wide range of conditions.

A report reviewing the present status of design data on heat flow through glass was prepared for committee study. A paper reviewing the Society's work in this field was presented by G. V. Parmelee before the *American Ceramic Society* in Cincinnati in April 1949.

It is gratifying to be able to report substantial technical and financial support of these programs during 1949. The work to date has all been fundamental in character and has involved no *testing* of any commercial products whatsoever. The support given to these studies over the past few years indicates what can be accomplished if a long-range research program is soundly organized and developed, and adequately presented to interested segments of this and allied industries. It is believed that the design data, when fully developed, will indicate how important these studies have been to the air conditioning industry.

Cooling Loads—Periodic Heat Flow

At Cornell University Prof. C. O. Mackey is continuing his work on the sol-air thermometer under a cooperative agreement with the Society. Studies are under way to discover the effect of different materials of construction and different sizes of exposed surface on the readings given by the instrument. At Tulane University, also under a cooperative agreement, sol-air temperature data have been developed for New Orleans. They will be presented early in 1950 and, to the data already available for New York City and Lincoln, Neb., will add values for a humid area where the effect of water vapor in the atmosphere may be significant.

Heat Pump

The TAC on the Heat Pump held its organization meeting in January 1949 and began work on the determination and evaluation of satisfactory heat sources for heat pump applications in temperate zones. It has maintained close contact with all other known bodies interested in this general field, and committee members have prepared outlines covering existing information, investigations and suggestions for research on the following heat sources: air, earth, water, solar energy. It is planned to issue a composite review of the information gathered to date, to act as background material for future studies.

Under a cooperative research contract with the Society, Dr. R. C. Jordan of the University of Minnesota is making a study on the availability of solar energy as a potential heat source for the heat pump, the design of solar radiation absorbers and the use of storage media.

Panel Heating and Cooling

Studies designed *to obtain data which will permit the proper calculation and design of panel heating and cooling systems with the present emphasis on applications for human comfort* have been one of the major activities of the Laboratory during 1949.

To summarize briefly the work to date, experimental studies have been made with three concrete slabs, and the data thus obtained verified and the range of application extended, by means of an electrical analogue.

Analytical studies have been made of heat flow in a concrete panel when pipes are spaced uniformly and buried within a solid slab. Field tests have been initiated on heat flow from a concrete slab to the ground, as influenced by the type and location of insulation below the slab.

Tests have begun on plaster panels, with the tubing both below and above the metal lath.

Progress has been made in the preparation of a method of design for panel heating suitable for use in THE GUIDE. The bibliography of articles and references on panel heating and cooling has been brought up to date to the end of 1949, and will shortly be issued as a supplement to the bibliography prepared and distributed in 1948.

The tests made on concrete slabs covered three slabs of different thicknesses and with different depths of bury of the pipe. Pipe spacings were on 4-in. centers, thus enabling tests to be made at 4-in., 8-in., 12-in. and 16-in. centers. By using special equipment designed and constructed at the Laboratory, it was possible to set the test conditions so that the heat release from the upper surface of the slab was approximately 0, 25, 50, 75 and 100 percent of the heat supplied, the remainder being given off by the lower surface. Though most of the tests were made with the slab surface bare, some tests were made with the slab surfaces covered with carpet and carpet padding, with several thicknesses of insulation and with asphalt tile.

Fairly complete reports covering the various studies made to date have been prepared for committee study and will not be reviewed here. It is intended to present the main results to the Society at the 1950 Annual Meeting in Dallas and prepare summary reports for general use. It must be emphasized that the information secured to date is not in itself adequate for design purposes but forms an important part of the data required for the development of simple design procedures. The validity of using a thermal test system has been proved, the electrical analogue has been shown to be a convenient means of extending the range of thermal observations, the test data have confirmed the fundamental theory developed by mathematical analysis for uniformly-spaced pipes buried within a solid slab, provided the effects of the slab surface temperature-wave are negligible, or in other words, where the slab surfaces may be considered to be isothermal for practical applications. Some work has been done on the extension of experiment and theory to the case of slabs where the slab surfaces cannot be considered isothermal. Other studies have been commenced for the case of the slab on earth, where the pipes are in the slab-earth interface.

At Columbia University, under a cooperative agreement with the Society, Prof. Carl F. Kayan completed his study of the effect of idle tubes on the heat flow pattern in a concrete slab. Using electrical analogy methods, he not only confirmed the results obtained in the thermal studies made at the Laboratory but obtained interesting data on surface and slab temperature distribution.

Field Study

For the field study four frame, one-story, five-room houses of identical construction, except for under-floor insulation, were instrumented for underfloor and floor temperature and heat flow distribution studies. All houses face the same direction and are built on adjacent lots. Types of insulation are hollow tile and glass foam with some variations in application.

Thermal measurements are being currently made and will continue through the present heating season. A mechanical soil analysis has been made to assist in establishing soil thermal conductivity at the site.

Calorimeter Room

To provide facilities for the study of heat flow from the panel to the space, plans and drawings were made early in 1949 for a calorimeter room about 16 ft × 12 ft with an 8 to 10-ft ceiling. These plans were extensively modified in the early summer to accommodate the needs of the TAC on Sensations of Comfort. Plans approved late in the year are for a room 24 ft long and 12 ft wide with a movable ceiling of 12 ft maximum height. This room will be located in the upper Laboratory, with heavy service equipment located directly below in the lower Laboratory. Preliminary construction has begun, and many of the materials are now on order; the type of aluminum radiant panel selected is one that has been tried out commercially with considerable success.

The Laboratory has urgently needed facilities of this type ever since it was moved to the present permanent quarters. The staff anticipate that these facilities, when completed, will be kept in constant use for many different types of investigation.

Industry Support

The panel heating research program has received substantial support in 1949 from several trade associations as well as from a number of industrial organizations. The cost of the studies made in 1949 has, however, been borne almost equally by earmarked contributions and by general Society funds available to the Committee on Research. A substantial part of the funds contributed in 1949 has been carried over to the

1950 fiscal period in which expenditures, especially on the calorimeter room, are likely to be heavy.

Air Cleaning

As part of the plan to develop sound and acceptable test procedures, the Laboratory has made some studies on test dusts. A subcommittee on test dusts was set up early in the year to advise and assist in this part of the overall problem. In order to specify the characteristics which standard test dusts should possess, it seemed desirable to study the types of air contamination found in the atmosphere in different parts of the country and relate these to the types of material which should be used in accelerated-use tests. The Laboratory has played its part in such a study, and we are indebted to the Bell Telephone Laboratories for the loan of the four sampling units and to the three filter manufacturers who are cooperating with us in the study.

At the Laboratory various methods for determining size and particle shape characteristics of dusts have been studied and techniques developed. Problems in velocity and dust distribution in the test duct have been overcome and satisfactory sampling positions tentatively established.

A number of important questions remain to be answered before the Laboratory will be in a position to suggest test procedures. Similar problems exist in other countries and close touch is being maintained with other workers in the field.

A paper[1] being presented at the 56th Annual Meeting covers studies made a few years ago under a cooperative research agreement between the University of Minnesota and the Society and hitherto unreported.

Oil-Heat Institute

In cooperation with the *Oil-Heat Institute of America* engineering committee and its research subcommittee, a third investigation was made at the Society's Laboratory during 1949 to determine to what extent the combustion reference test unit might be used as a means of rating the burning quality of domestic fuel oils.

Instrumentation of the unit was improved with the addition of an air supply metering system and the use of a light reflection meter to evaluate the density of smoke deposit on smoke meter filter papers.

Test results with six oils of widely differing properties indicated that the unit was capable of distinguishing the respective smoking tendencies with reasonable reproducibility. Good correlation was obtained between the smoking tendency of these oils and several common indices of combustion. Turbulence of air supply and means of ignition were found to have a pronounced effect upon CO_2 as well as upon smoke density. It was concluded that in order to establish the true significance of the results obtained with a unit of this nature it would be necessary to investigate fundamental principles of fuel atomization, ignition, air-fuel mixing, and particle size in smoke indication.

A report has been made to the *OHIA* engineering committee, and the results of the three investigations made to date are being prepared for presentation as a research paper before the Society.

The Guide

Psychrometric Chart

(a) In line with the request of the Guide Publication Committee that the Laboratory assist in the development of a new psychrometric chart, H. B. Nottage, research associate at the Laboratory, has cooperated with a special subcommittee in preparing firstly a skeleton chart, and finally a large-scale master chart. This chart is now being retraced by an organization experienced in this type of work. A memorandum has been prepared describing the background of the chart, the principles upon which it is drawn and the proposed manner of its use. The chart and memorandum will shortly be presented to a representative group of Society members for criticism and discussion as a prelude to presentation at the 1950 Semi-Annual Meeting.

(b) Many members of the Committee on Research, and of the TA committees, as well as several staff members, have assisted in the revision of a number of Guide chapters. The Laboratory has assisted in the preparation of a number of new tracings. The TAC on Sound Control was responsible for the rewriting of the Chapter on Sound Control in THE GUIDE. Members of the TAC on Industrial Ventilation have been responsible for revision or rewriting of the Chapters on Air Cleaning, Air Contaminants, Industrial Air Conditioning and Industrial Exhaust Systems in THE GUIDE. The director of research served as an ex-officio member of the Guide Publication Committee to insure close liaison between it, the Committee on Research and the various technical advisory committees.

Industrial Ventilation

In addition to assisting the Guide Publication Committee in revising or rewriting certain chapters in THE GUIDE, the TAC on Industrial Ventilation has conducted a comprehensive survey of industrial spot cooling installations and practices by means of a questionnaire sent to over 400 organizations. The returns were gratifying and replies are now being analyzed.

Odors

During 1949 attention was directed to the problem of odors in occupied spaces by setting up a Technical Advisory Committee on Odors to *study odor problems; including the formation, methods of measurement and control of odors, and the physiological reactions to them.* Two meetings were held and plans made to develop active studies in this field in 1950. It is evident that the problem is an important one, but there are some wide differences of opinion as to the best methods of attack.

Sorbents

The TAC on Sorbents is at work on a recommended method for the testing and rating of sorption-type dehumidifiers.

Research Publicity and Promotion

Senior staff members have participated in inter-society activities with *AIChE, AIEE, ASME, ASRE,* and the *IES.* Close liaison has been maintained with workers in our own and allied fields here and abroad.

Five members of the staff spoke on the research program before the Northern Ohio Chapter in May. G. V. Parmelee spoke at two chapters of the Society during 1949 as well as at the meeting of the *American Ceramic Society.* The director of research visited 11 chapters in 1949 and also spoke before the United Nations Scientific Conference on the Conservation and Utilization of Resources, the *National Association of Master Plumbers* and the 18th Annual Forced Warm Air Conference at Michigan State College.

Visits to chapters by members of the Laboratory staff appear to serve perhaps better than most other media to bring before the membership the purpose and significance of the Society's research program. Though substantial progress has been made in research publicity and promotion during 1949, it is and must be a continuing program, deserving of careful planning and the use of a variety of media. The director and other Laboratory staff members cooperated with the Society's Public Relations Counsel in the preparation and distribution of a booklet entitled *Research—Investment in Progress.*

Acknowledgments

On behalf of the Laboratory staff the writer takes this opportunity to express sincere appreciation for the encouragement and support given to it by the Society officers and Council, and especially by the Chairman and members of the Committee on Research and the members of the various Technical Advisory Committees. Although not all was accomplished that was hoped for at the beginning of the year, the year end saw research activities on a firm footing, both technically and financially. The staff look forward with confidence to 1950 in the belief that the work in which they are engaged will bring substantial benefits not only to the heating, ventilating and air conditioning industry but also to the general public.

The writer expresses thanks to all Laboratory staff members for their loyal service and unfailing cooperation.

[1] Resistance Gradients through Viscous Coated Air Filters, by F. B. Rowley and R. C. Jordan. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, December 1949.)

PARTICIPANTS IN THE 1949 ASHVE RESEARCH PROGRAM

November 1, 1948—October 31, 1949

*Air Devices, Inc.
*Airkem, Inc.
Aluminum Company of America
*American Air Filter Co., Inc.
*American Blower Corp.
*The American Brass Co.
**American Iron and Steel Institute*
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Wheeling Steel Corp.
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*Pittsburgh Corning Corp.
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*Raytheon Mfg. Co.
*Research Products Corp.
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Sears, Roebuck and Co.
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Spencer Thermostat Co.—Metals & Controls Corp.
†*Structural Clay Products Institute*
Surface Combustion Corp.
The Timken-Detroit Axle Co.
The Trane Co.
The Tremco Mfg. Co.
*U. S. Navy—Office of Naval Research
**U. S. Public Health Service—National Institutes of Health*
*United States Testing Co., Inc.
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**Earmarked and General participation
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PARTICIPANTS IN THE 1950 ASHVE RESEARCH PROGRAM

November 1, 1949—December 31, 1949

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Treasurer

ASHVE Meeting, Exposition at Dallas

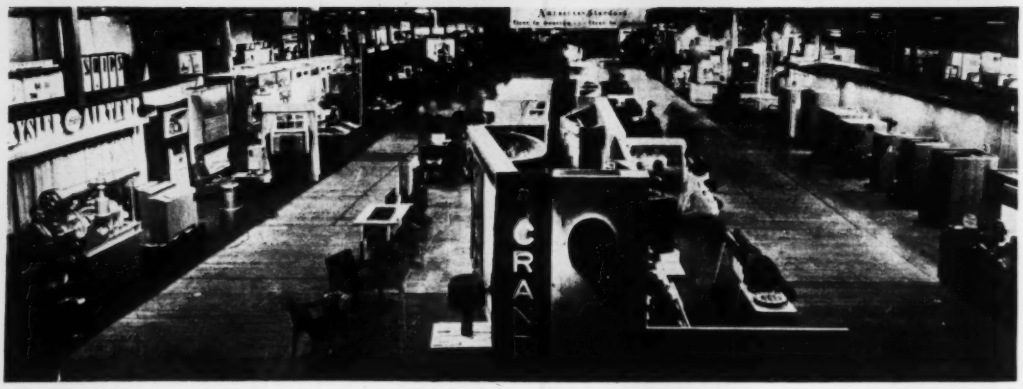
SOME HIGH-LIGHTS PICTURED

(Top) Stanley W. Foran, public relations and marketing counsel, Dallas, speaks on "Freedom Isn't Free" at the welcome lunch at the annual meeting of the ASHVE.

(Left Center) A. E. Stacey, Jr., immediate past president of the ASHVE congratulates Charles F. Roth, exposition manager. C. Rollins Gardner, general chairman for the ASHVE meeting, concurs.

(Right Center) R. L. Thornton, Sr., chairman of the board of the Mercantile National Bank at Dallas, cuts the ribbon opening the Southwest Air Conditioning Exposition while L. E. Seeley, Lester T. Avery, A. E. Stacey, Jr., C. Rollins Gardner, and Charles F. Roth look on. Herman Blum, president of the North Texas Chapter, is behind Dean Seeley.

(Bottom) A small part of the display in the Agriculture Building.



Summary of Chapter Meetings*

ATMOSPHERIC POLLUTION DISCUSSED AT NORTHERN OHIO MEETING

A talk on atmospheric pollution was given by H. F. Hebley, director of research, Pittsburgh Consolidation Coal Co., before 90 members and guests of the Northern Ohio Chapter on December 13, 1949. In discussing *Influences Causing Atmospheric Pollution*, he described pollution carry-off by natural means and the various geographical and meteorological conditions which upset this carry-off.

One of these phenomena, Mr. Hebley said, is the temperature *inversion* or a relatively warm air mass accompanied by low winds which prevents natural carry-off and may completely seal off a valley community; the recent Donora disaster was a condition of this sort. Mr. Hebley cited Los Angeles, where almost no coal is burned, as an example to emphasize that the most stringent smoke abatement measures cannot prevent low visibility during a prolonged inversion.

Mr. Hebley warned against scientifically and statistically unsound propaganda in regard to atmospheric pollution and its control. He described the city planning of Manchester, England, to point out the ventilation and filtration value of open spaces within a city as provided by parks.

The technical skill is at hand to solve problems of visible smoke if the expenditure is great enough, Mr. Hebley emphasized. However, the problem of smaller particle aerosol pollution is still in the research stage. In order to solve this phase the cooperation of mechanical engineers, chemists, meteorologists, statisticians, and the medical profession must be enlisted.

By way of comment, H. G. Dyktor, chief of the Cleveland Division of Air Pollution Control, stressed the added need for public education on air pollution. Comments on local meteorological conditions were offered by C. G. Andrus, chief Forecaster of the Cleveland Weather Bureau Station.

At the Northern Ohio Chapter meeting: *(l. to r.)* R. W. Dickson, Jr., program chairman; H. F. Hebley, speaker; R. L. Byers, Chapter president; and W. M. Rowe, vice president

• **CINCINNATI**—December 6, 1949. Prof. L. G. Seigel, Case Institute of Technology, Cleveland, spoke at the December meeting. Professor Seigel discussed the operation of air conditioning coils under different loading conditions and described various control methods with illustrations on a psychrometric chart.

A. H. Gerdsen spoke on the chapter's entertainment program and F. W. Wilson on Membership. K. B. Little discussed the 56th Annual Meeting in Dallas, while H. E. Sproull, a member of ASHVE Council, Cincinnati, gave a talk on the By-Laws of the ASHVE. Attendance 46.

• **DELTA**—December 13, 1949. The use of absorption refrigeration in air conditioning was the subject of the talk given by G. E. May of New Orleans Public Service, Inc., New Orleans. The speaker was introduced by R. B. Guest, president of the Delta Chapter. Mr. Guest also announced that chapter member Walter Cooke has been named principal speaker at the *Louisiana Engineering Society* meeting in January under the sponsorship of *ASRE*.

A report was given by treasurer Fritz Gutknecht. Attendance 27. Attendance ratio 0.29.

• **GOLDEN GATE**—December 1, 1949. A Life Membership certificate was presented to N. W. Downes by Dr. Baldwin M. Woods, past president of ASHVE, Berkeley, Calif., at the meeting in San Francisco. A report was given by L. H. Cochran on the finance committee's report.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

The chapter members and guests were then entertained by a color film on Hawaii. Following the movie, there was community singing to the accompaniment of an accordion. Attendance 76. Attendance ratio 0.27.

• **ILLINOIS**—December 12, 1949. T. H. Urdahl, consulting engineer, Washington, D. C., and a member of the Society's Committee on Research, was guest speaker at the December meeting in Chicago, his

T. H. Urdahl
Washington, D. C.

subject being *Trends in Duct Design and Distribution*. Mr. Urdahl compared the trend in decreased duct sizes with the similar tendency apparent in water heating and cooling systems.

Although custom has indicated low speed air flow through large ducts, Mr. Urdahl pointed out the economy of building design no longer permits such large duct sizing. He used his background in air handling design in naval vessels to explain the results of this new tendency toward smaller duct sizes. He pointed out that smaller duct sizing results in higher air velocities which, of course, imply a greater noise potential. He further clarified the noise problem and outlined steps to be taken in eliminating this hazard. Mr. Urdahl explained that although power cost is increased due to the smaller duct sizing, the additional expense is usually insignificant.

V. J. Jenkinson, Toronto, Ont., a past president of the Ontario chapter, extended an invitation for the coming Semi-Annual Meeting 1950. Attendance 133. Attendance ratio 0.23.

• **IOWA**—December 14, 1949. Trends in duct design were described by T. H. Urdahl, Washington, D. C., at the December meeting in Des Moines. Mr. Urdahl pointed out that the high velocity considerably affects the design of duct takeoffs, dampers and outlets, as particular attention must be paid to sound levels created by the high velocity air. He gave illustrations of typical installations.

D. E. Schroeder, construction inspector at Iowa State College, Ames, Ia., gave a report from the committee on the heating & ventilating school to be held at the college in March and reported that it would be held in conjunction with a meeting of the *National Warm Air Heating & Air Conditioning Association*, which will arrange the program and speakers. Attendance 32.

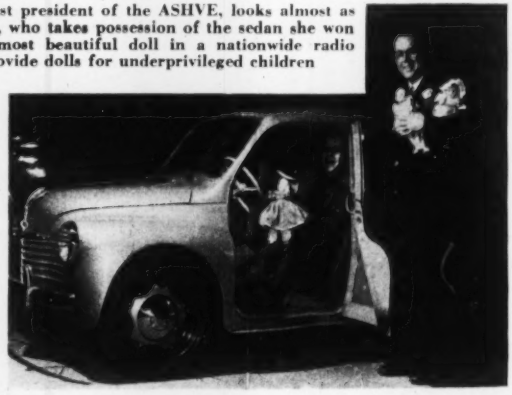
• **MASSACHUSETTS** — December 8, 1949. This meeting was held in Boston and was held jointly with the annual social meeting with the Boston section of the *ASRE*. At the head table, the officers of both societies were seated and these included W. H. Shipp, president, Massachusetts Chapter of ASHVE, and D. Bratton, president, Boston section of *ASRE*. Master of ceremonies Daniel Ricker of *ASRE* introduced the speaker, E. A. Rowlands, whose topic was *Sports Around America*. An added feature was the showing of a film on air power. Attendance 93. Attendance ratio 0.36.

• **NORTHEASTERN OKLAHOMA** — December 13, 1949. Speaker of the evening at the December meeting in Oklahoma City was J. W. May, technical director, Air Filter Division, American Air Filter Co., Louisville, Ky., who spoke on electrostatic air filters. Newly elected Pres. A. D. Holmes presided over part of the meeting when the gavel was turned over to him by retiring Pres. W. R. Lee. The treasurer gave his annual financial report. Attendance 36. Attendance ratio 0.71.

• **ONTARIO**—December 21, 1949. At the meeting in Toronto, First Vice President Lester T. Avery, Cleveland, was guest speaker and spoke on *Good Air—Good Work*. Mr. Avery also described chapter activities and the development of the Society in the past two years.

N. W. Kingsland, chairman of the *On to Dallas Committee*, reported on the forthcoming 56th Annual Meeting, and a total of 24 members indicated that they planned to attend the Dallas Meeting from the Ontario Chapter. Some of these members will be accompanied by their wives. A report on the 1950

M. F. Blankin, past president of the ASHVE, looks almost as happy as his wife, who takes possession of the sedan she won by dressing the most beautiful doll in a nationwide radio contest to provide dolls for underprivileged children



Summer Meeting at Muskoka Lakes was given by J. H. Fox, general chairman, committee on arrangements. G. P. Cooper was appointed to the Board of Governors to fill the vacancy created by the death of H. A. Baxter. Attendance 115. Attendance ratio 0.40.

• **PITTSBURGH**—December 12, 1949. Types of basementless houses were described by P. R. Achenbach at the meeting in Pittsburgh. Mr. Achenbach, assistant chief, Heating and Air Conditioning Section, National Bureau of Standards, Washington, D. C., spoke on new design methods for simplified warm air heating systems, with ducts shortened, air return eliminated, dampers eliminated and size of blower reduced. He described the application of simplified systems to two types of houses as follows: (1) houses with concrete floors, and (2) houses with crawl space below. The speaker was introduced by A. F. Metzger. A report of the Society's By-Laws was given by T. F. Rockwell, chairman of the Society's Admission and Advancement Committee. Future programs were outlined by the program committee, with the January meeting being designated as past presidents' night. Attendance 32.

• **ROCKY MOUNTAIN**—December 7, 1949. At the December meeting in Englewood, Colo., B. A. Brickham, heating and ventilating engineer, Denver, continued his series of talks on heating systems. He used charts showing design of forced warm air and panel heating systems. He showed how to predetermine heat losses and size the supply and return ducts and branches.

Mr. Brickham also outlined the steps involved in the design and installation of a panel heating system, with floor coils used in a concrete slab. Pipe size, pipe spacing, lower temperatures, pipe friction and pump size were topics of discussion.

Reports were given by representatives of the program, membership and code committees.

E. J. McEahern was elected delegate, and Fred Janssen, alternate to the 56th Annual Meeting to be held in Dallas, January 1950. Attendance 55. Attendance ratio 0.34.

• **ST. LOUIS**—December 6, 1949. The speaker of the evening at the December meeting was J. B. Killebrew, president, Killebrew Engineering Co., St. Louis, who discussed *Selecting the Proper Heat Exchanger for Your Job*. The following points were emphasized in the talk:

Proper conditions and requirements are very essential in design to arrive at economical exchangers. Mechanical means of cleansing are preferred by the speaker. Exchangers should be of a type providing ease of cleaning. Care must be given to baffling of liquid exchangers especially for viscous liquids. Special consideration should be given to pressure drop through exchangers. The speaker also discussed the conditions under which instantaneous heaters could be selected advantageously.

A report on the Chapter Delegates Committee was given by G. W. F. Myers. Other reports were given by the membership committee and by the treasurer.

H. A. Wolbridge, Wolbridge Engineering Co., Kansas City, Mo., was one of the guests at the meeting. Attendance 73.

• **SOUTHERN CALIFORNIA**—December 21, 1949. Cooperation among engineers was stressed by R. E. Phillips, mechanical and electric engineer with Westinghouse Electric Corp., Los Angeles, in his talk before the chapter meeting held in Beverly Hills. Mr. Phillips traced the local history of air conditioning during the last 25 years and gave a heating engineer's viewpoint of collaboration between architects, engineers and tradesmen. Members of the audience who directed questions to Mr. Phillips included the following: Philip Hawgood representing the contractors; J. L. Blake representing owners; C. S. Anderson, J. S. Earhart, and M. C. Greiner representing equipment manufacturers. Attendance 93.

• **WASHINGTON, D. C.**—December 14, 1949. *Coal—Energizer of the Machine Age* was the topic chosen by W. C. Lynch at the December meeting in Washington. Mr. Lynch, who is associated with the Bituminous Coal Institute, compared oil and coal reserves, and described new coal burning equipment. Vice Pres. F. M. Thuney presided over the meeting in the absence of Pres. P. R. Achenbach and this meeting was an innovation since it was a luncheon meeting rather than an evening meeting. Attendance 22.

• **WESTERN MICHIGAN**—December 5, 1949. Ernest Szekely, Milwaukee, Wis., treasurer of ASHVE, was guest speaker at the meeting held in Kalamazoo. Mr. Szekely spoke on *Design of Fans and Their Application*. He also described the Society's Research Program.

A report was given by K. E. Robinson, vice president of the chapter, on the new By-Laws, and S. H. Downs, chairman of the Constitution and By-Laws Committee, also spoke on that subject. Attendance 75.

Student Branch

UNIVERSITY OF TEXAS—December 1, 1949. At the December meeting on the campus in Austin, Fred Venable of the Texas State Health Department spoke on *The Role of the Engineer in the Industrial Hygiene Phase of Public Health*. The speaker was introduced by I. W. Wilke. Pres. D. S. Belvin announced that the joint meeting with the Texas A & M Student Branch would be held on December 13. Discussion on a change in meeting night took place and it was decided to canvass members by mail. Attendance 18. Attendance ratio 0.31.

OBITUARIES

JOSEPH C. ALBRIGHT

Joseph C. Albright, Baltimore, Md., died last September of a heart attack. He was born November 15, 1895 in Rossville, Ill., and was educated in public schools there. During World War I, he served in the French Army with the Lafayette Escadrille. In 1920 he received a B.S. in Mechanical Engineering at the University of Illinois, Urbana. Following graduation, he spent the next 10 years with Bailey Meter Co., Cleveland, Ohio.

In 1930 he became associated with the Marley Co., Kansas City, Kans. During his tenure with this company, he was largely responsible for the compilation and editing of the booklet Summer Weather Data which is still in use by engineers of air conditioning design.

From 1940 to 1943 he was affiliated with the C. H. Wheeler Mfg. Co., Philadelphia, Pa. In 1944 he joined the Davison Chemical Corp., Baltimire, Md., and served as manager of the consulting engineering section, engineering division, until early in 1949. During this time, he became interested in the development of preservation measures for long term storage of military material and on research in the field of static desiccants, a project which was interrupted by his death. As a member of ASHVE, he served on the TAC on Weather Design.

He is survived by his widow and one son.

FREDERICK R. BISHOP

Frederick R. Bishop, Detroit, Mich., died early in December, 1949, at the age of 70.

He was born July 29, 1879, in Detroit and was educated in public schools. He was affiliated for nearly 17 years with the U. S. Heater Co. and U. S. Radiator Corp. During these years he rose from office boy to manager. His other experience included four years with Lord and Burnham Co., Chicago, as western sales manager; Hawkeye Supply Co., Mason City, Ia., as manager of the heating dept.; and Kelley-How-Thompson Co., Duluth, Minn., as manager.

In all of his experience he had charge of heating engineering work, and laying out various types of systems, as well as installations.

He joined the ASHVE in 1921 and was a past president of the Michi-

F. R. Bishop

gan Chapter of the Society. At his death, the Michigan Chapter expressed sympathy in the following resolution which was incorporated in the official minutes:

Mr. Bishop was a faithful member of the Society and his connections with it brought him a host of friends and the universal respect of his fellow members.

THEREFORE, be it resolved that the Michigan Chapter of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS expresses its sympathy and sorrow in the death of one of its members and takes this opportunity to extend its condolence to the widow and family.

NOAH M. SIMMONS

Noah M. Simmons, Indianapolis, Ind., died December 16, 1949, after an illness of three months. Long active in heating and ventilating circles in the Middle West, he founded the Noah M. Simmons Co. of Indianapolis, Ind. Besides being a member of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, he was also a member of the *Heating, Piping and Air Conditioning Contractors' National Association* and the *Construction League of Indianapolis*.

He was born in 1895 in Wilkinson, Ind., and attended public schools. From 1902 to 1908 he was a steamfitter's helper and a steamfitter with the W. H. Johnson & Co., Indianapolis. From 1908 to 1910, he installed heating systems in various buildings including the Hancock County Court House and the Franklin, Ind. College. In December 1910 he became associated with the American Gas and Electric Co. of New York in its Muncie, Ind. plant. He also supervised the installation of new piping in the plant and was promoted to chief engineer.

From 1912 to 1932 he had experience in steamfitting, plumbing, heating and ventilating and in 1932 he organized his own business as a heating and piping contractor.

He is survived by his widow, two sons, a daughter, two sisters and three brothers.

GEORGE J. WALLACE

George J. Wallace, Life Member of the Society, died recently at the age of 77. He was born January 8, 1872, in Brooklyn, N. Y. and attended public schools there. In 1890 he entered the heating and ventilating field and continued until 1899 when he formed his own company, the firm of George J. Wallace.

His experience in the field consisted of affiliations with Baker Smith & Co. and also Wallace & Gary. He had charge of various buildings and designed heating, power and mechanical equipment for such structures as the Penitentiary Bldg., Blackwells Island, N. Y., Convent Bldg., Queens, L. I., and St. Mary's Hospital, Jamaica, L. I.

He was elected a Life Member of the Society in 1942.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month, 124 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by February 25, 1950, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ADAM, W. N., Office Mgr. and Estimator, William A. Adam Co., Detroit, Mich. PROPOSERS: K. J. Wagoner, R. H. Oberschulte. SECONDERS: E. F. Glanz, D. S. Falk.

BAMBRICK, H. J. D., Ventilation Engr., Hudson Bay Mining & Smelting Co., Ltd. & Subsidiaries, Flin Flon, Man., Canada. PROPOSERS: E. H. Price, A. W. Moss. SECONDERS: J. R. Stephenson, D. F. Michie.

BAUERNSCHMIDT, J. G., Partner, Bauernschmidt & Garey, Mfrs. Repr., Baltimore, Md. PROPOSERS: E. L. Crosby, G. M. Baldwin. SECONDERS: W. G. Robertson, Jr., W. P. Flanigan.

BERGERON, P. X., Mgr., St. Louis Br., United States Radiator Corp., St. Louis, Mo. PROPOSERS: J. J. Blackmore, B. L. Evans. SECONDERS: E. T. Clucas, G. H. Bemarkt.

BON, R. P., Milwaukee, Wis. PROPOSERS: J. A. Lofte, L. C. Plaehn. SECONDERS: V. P. Hansen, L. E. Boehler.

BOTTENHORN, F. J., III, Sales Engr., Minneapolis-Honeywell Regulator Co., Cincinnati, Ohio. PROPOSERS: F. W. Wilson, W. C. Reckman. SECONDERS: B. T. Hauer, E. W. McNamee.

BRYAN, E. E. Supt., Buildings and Power Plant, Vanderbilt University, Nashville, Tenn. PROPOSERS: C. S. Leopold, P. R. Jarratt*. SECONDERS: F. J. Lewis*, F. B. Warfield*.

BUNCH, FRANK, Sr. Tech. Engr., Messrs. Hoare, Lea & Partners, Cons. Engrs., Birmingham, England. PROPOSERS: C. P. How, L. A. Bawden. SECONDERS: R. E. Otto, Bernard Smith.

BURNETT, E. L., Sales Engr., Charles D. Jones & Co., Kansas City, Mo. PROPOSERS: John Douglass, C. D. Jones. SECONDERS: E. E. Ralston, D. M. Allen.

CLARK, R. H., Owner, Robert H. Clark Co., Huntington Park, Calif. PROPOSERS: Leo Hungerford, R. J. Petersen. SECONDERS: R. A. Lowe, L. J. Helms.

COOK, W. L., JR., Vice-Pres., P. S. Cook Co., Cheyenne, Wyo. PROPOSERS: A. W. Cooper, J. J. Johnson. SECONDERS: H. W. Marshall, N. H. Brickham.

DEAN, R. T., Sales Engr., The Trane Co., Duluth, Minn. PROPOSERS: J. G. Hamm, J. A. Sandberg. SECONDERS: William McNamara, A. B. Algren.

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HEAVEN, L. A., Mgr., Heaven Engineering Co., Kansas City, Mo. PROPOSERS: C. E. Gay, Sr., L. P. Heaven. SECONDERS: Paul Heckert, H. H. Lewis.

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HOGAN, G. W., JR., Sales Engr., Warren Webster & Co., Cincinnati, Ohio. PROPOSERS: G. B. Houlistan, C. D. Weaver. SECONDERS: L. G. Seigel, M. E. Mathewson.

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HORSWILL, W. B., Office Mgr., Wiggs, Walford, Frost & Lindsay, Toronto, Ont., Canada. PROPOSERS: G. L. Wiggs, D. L. Lindsay. SECONDERS: L. C. A. Walford, John Everetts, Jr.

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* Non-member

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• **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, J. C. Cox, 417 W. Mississippi, Ruston. SECRETARY, H. D. Hayes, Box 409 Tech Station, Ruston.

• **NORTH CAROLINA STATE COLLEGE:** Organized 1948. Headquarters, Raleigh, N. C. PRESIDENT, J. J. Andrews, 710 Harvey St., Raleigh. SECRETARY, E. A. Stroupe, Jr., 416 Halifax St., Raleigh.

• **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, M. B. Larson, 2311 N. E. Hancock, Portland 12. SECRETARY, Helen P. Lankow, 1349 S. E. Birch St., Portland 14.

• **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, D. M. Williams, c/o W. T. Miller, Mechanical Engineering Bldg., Purdue University, W. Lafayette. SECRETARY, J. D. Tuttle, 359 Northwestern Ave., W. Lafayette.

• **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, R. N. Hughes, Box 914, College Station, Tex. SECRETARY, W. J. Bowen, Box 1913, College Station, Tex.

• **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets First Tuesday. PRESIDENT, L. M. Blanchette, 2245 Holcomb, Detroit 14. SECRETARY, S. H. Kosinski, 4439-30th, Detroit 10.

• **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. PRESIDENT, J. L. Williams, 5728 Central, Kansas City. SECRETARY, R. C. Umholtz, 2732 Michigan St., Topeka, Kans.

• **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. PRESIDENT, D. S. Belvin, 2837½ San Gabriel, Austin. SECRETARY, G. G. Marwill, 708 West 24½ St., Austin.

Don't Trap Vapor in Walls!

HEAT FLOW thru space of NON-INSULATED WALL: Conduction 5% to 7%; Convection 15% to 28%; Radiation 65% to 80%.

Use an insulation which has zero permeability to vapor, is non-condensation forming, can retain no moisture, and will force out fortuitous vapor

To force out vapor, permeability of insulations should be AT MOST 1/5th that of outer walls. Otherwise, trapped inside walls, moisture REDUCES insulation values; and DAMAGES wood, plaster and paint.

Water vapor at 32°F has a volume 205,625 that of water. To prevent condensation, and allow for evaporation, a large space is needed between outer walls and insulations which permit vapor to flow through. Reducing the space or the temperature converts vapor to moisture, retains existing moisture.

Most "vapor barriers," asphalt paper for example, are only waterproof. Water molecules are too large to pass through the pores. But minute particles of gas, such as water vapor, sieve through and accumulate in wall spaces and in ordinary insulations. Vents at top and bottom have little value. Vapor travels the shortest distance to the cold wall and condenses.

Breaks in the outer wall, or infiltration under flanges because of vapor pressure, or seasonal changes of direction of heat flow and vapor, sometimes permit vapor or moisture to leak into the space between wall and insulation.

With Infra, they will be PUSHED OUT as vapor, gradually, through the outer walls by PRESSURE FROM WITHIN; because compared to Infra's ZERO PERMEABILITY to vapor, the outside walls have a substantial permeability. Infra Multiple Aluminum Accordion Insulation is also non-condensation-forming, and can retain no moisture.

THERMAL FACTORS, INFRA TYPE 4

Down Heat C .064 equals 5" Dry Rockwool
Up Heat C .109 equals 3" Dry Rockwool
Wall Heat C .105 equals 3½" Dry Rockwool

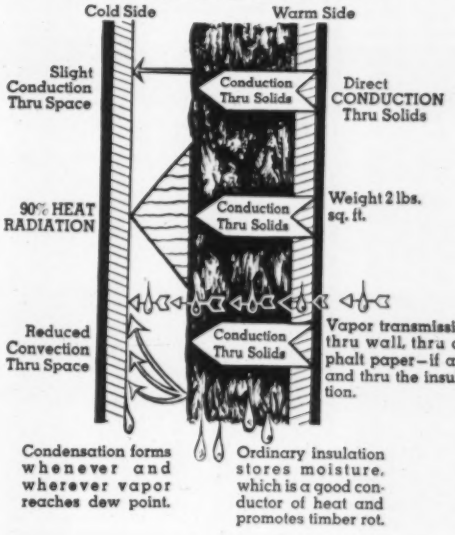
Vapor Permeability equals ZERO

The cost of Infra Type 4 installed between wood joists, material and labor, should be under 8¢ sq. ft. in new construction.

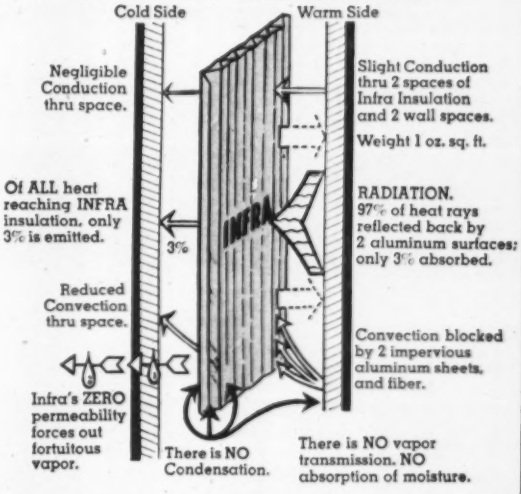
Write Infra **for a FREE COPY of the National Bureau of Standards 14-page booklet on "Moisture Condensation in Building Walls." *Address Dept.* 11-2.**

WRITE FOR PRICE LIST OF INFRA'S INSULATIONS

HEAT & VAPOR FLOW THRU WALL SPACE
WITH ORDINARY INSULATION


Cold Side
Warm Side
Slight Conduction Thru Space
Conduction Thru Solids
Direct CONDUCTION Thru Solids
90% HEAT RADIATION
Conduction Thru Solids
Weight 2 lbs. sq. ft.
Reduced Convection Thru Space
Conduction Thru Solids
Vapor transmission thru wall, thru asphalt paper—if any and thru the insulation.
Condensation forms whenever and wherever vapor reaches dew point.
Ordinary insulation stores moisture, which is a good conductor of heat and promotes timber rot.

HEAT & VAPOR FLOW THRU WALL SPACE
WITH TYPE 4 INFRA INSULATION


Cold Side
Warm Side
Negligible Conduction thru space.
Slight Conduction thru 2 spaces of Infra Insulation and 2 wall spaces.
Weight 1 oz. sq. ft.
Of ALL heat reaching INFRA insulation, only 3% is emitted.
3%
INFRA
RADIATION. 97% of heat rays reflected back by 2 aluminum surfaces; only 3% absorbed.
Reduced Convection thru space.
Convection blocked by 2 impervious aluminum sheets, and fiber.
Infra's ZERO permeability forces out fortuitous vapor.
There is NO Condensation.
There is NO vapor transmission. NO absorption of moisture.

MULTIPLE ACCORDION ALUMINUM and TRIANGULAR REFLECTIVE AIR CELLS

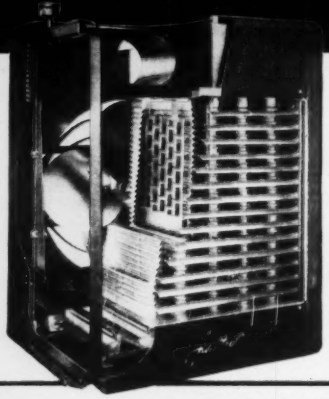
INFRA INSULATION, INC.
10 Murray St., N. Y., N. Y. COrtlandt 7-3833

Anyway you look at it...

THE NEW IMPROVED Janitrol GAS-FIRED UNIT HEATERS have everything

★ NEW SMART APPEARANCE ★ NEW DESIGN FEATURES ★ PROVEN PERFORMANCE ★ LONG LIFE CONSTRUCTION ★ EASY SERVICEABILITY

A. G. A. Approved for all gases including L. P.



Field engineering helped build Janitrol's new, advanced line of Unit Heaters.

Valuable user performance data and field service information were correlated over a three year period as a guide to determine the most practical improvements required for better industrial and commercial heating. Then the actual design and construction improvements in the new Janitrol Unit Heater line became the responsibility of Surface Combustion engineering staff.

This policy of analyzing all practical heating requirements first has resulted in equipment with far greater user acceptance. So, you can count on Janitrol for not only advanced design and efficiency but also for practical, easy maintenance under all kinds of rugged operating conditions.

Because more and more Janitrol Unit Heaters are being installed by retailers, in places of amusement, restaurants, and all kinds of service businesses, special attention was given to smart appearance and compactness.

In most cases Janitrols will be found to be more compact and to provide more headroom than other equipment. Write today for complete specifications and installation data.

A FEW OF JANITROL'S MANY OUTSTANDING FEATURES

★ New Cartridge Type Ribbon Burners: Designed for easy removal and interchangeability for different type gases, special chrome alloy steel for high temperature and corrosion resistance. Separate burners for each heat exchanger make for high efficiency and even heat distribution.

★ Improved, Long-Life Tubular Heat Exchangers: High efficiency of Janitrol's unique design makes possible extreme compactness. Interior suspended alloy steel turbulators accelerate heat transfer. Improved vertical design minimizes dust and dirt collection, contributes to better air flow.

★ Improved, Automatic Pilot: New actuating lever and switch design assures long life, positive operation. While pilot is more positively positioned, assembly can be removed in a few seconds.

★ Combination Fan and Limit Control: Only Janitrol provides dual overheat safeguard as standard equipment, in case of stuck gas valve fan continues to dissipate heat preventing damage to unit or adjacent area.

★ Motor and Fan Assembly: Resilient mountings minimize vibration and noise. Overlapping blade type fans provide maximum air velocity with quiet operation. Direct-a-Flow housing provides uniform airflow over entire unit.

★ Smart, Quality Appearance: Smooth dark grey hammerloid baked enamel finish on steel casing fits unobtrusively in most surroundings. Bottom panel is hinged for opening without removal for inspection of burners and bottom of heat exchangers.

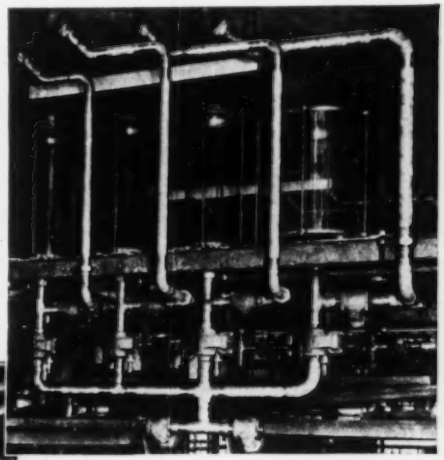
SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

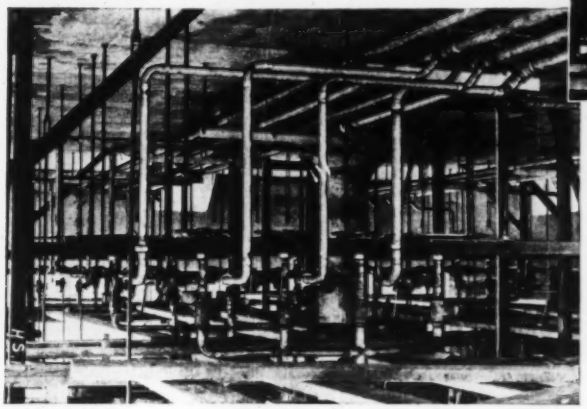
EASY-FLO SOLVED
THIS "SWEET" TUBING PROBLEM

In planning the recent addition to the LIFESAVER Corp. plant in Port Chester, N. Y., a critical question was — what to use for piping the sugar and corn syrup solution through the manufacturing process.

Thin-wall stainless steel tubing was finally chosen because it was not affected by the fermenting tendency of the sugar solution and it eliminated threaded joints in which ferment lodged and bred fungus.

Now came the question—*what's the best way to join stainless steel tubing?* After three months of trials and tests, the answer was clear—*braze with EASY-FLO.* For this low temperature silver alloy *proved* that it did a fine job of joining stainless steel —that it was easy to apply—that its joints, like the tubing, were not affected by the sugar solution.





2200 FEET OF STAINLESS STEEL TUBING in sizes of 1½" to 4", with stainless steel fittings, make up the system through which the sugar solution flows down from storage vats on the 6th floor to measuring jars, to premelters, to cookers. It's all assembled with EASY-FLO into a one-piece channel that will never leak or corrode.

Lockwood Greene Engineers, Inc.
N. Y. City—Architects and Engineers

John Winkle, Portchester, N. Y.
Plumbing Contractor

GET THE FACTS ON JOINING PIPES AND TUBING WITH *EASY-FLO*

Bulletin 17 gives the details of the surprisingly simple, fast, low-cost procedure. Bulletin 12-A gives you the details about EASY-FLO. Write for copies today.

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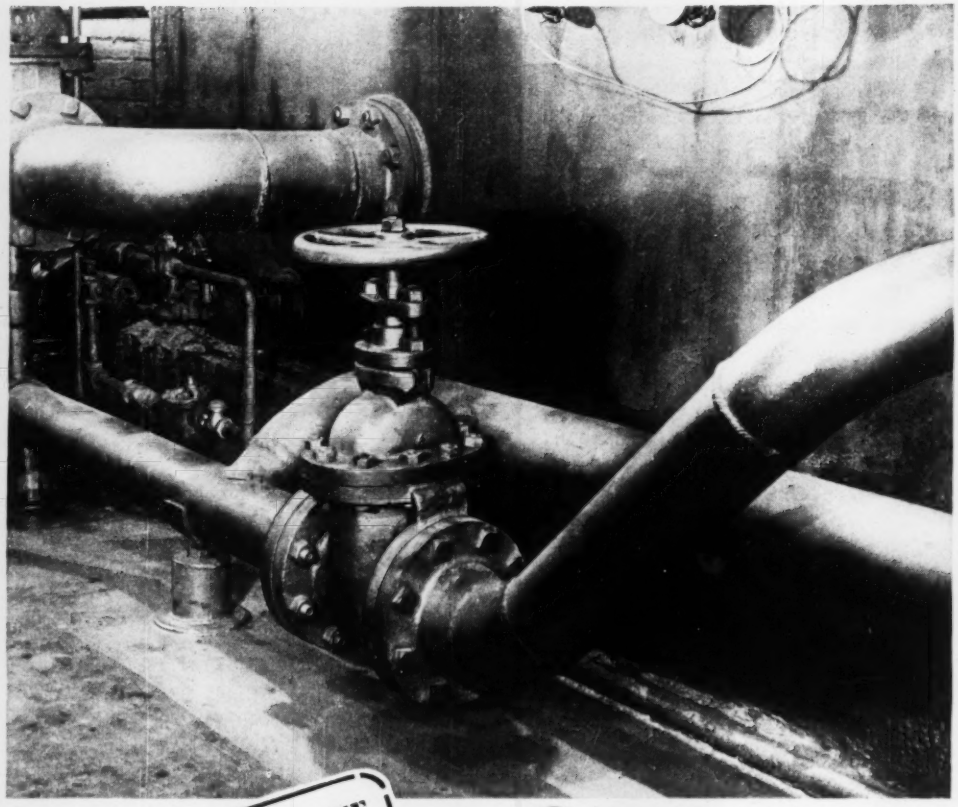
How to cut corners that cost



ANOTHER JOB DONE BETTER WITH GLOBE WELDING FITTINGS

PIPING "corners" can be costly—costly in initial installation, continual maintenance, flow resistance, pressure-loss, erosion, and corrosion.

You can "cut the corners that cost" with Globe Welding Fittings. Installation is simpler—faster. Your piping is safer, stronger with less weight — needed space reduced — insulation is easier and faster. There is less chance for erosion, corrosion, and leakage to develop because of the smooth inner walls, true radii and circularity of Globe Welding Fittings. Liquids and gases flow smoothly with less resistance and pressure-loss.

Decide to "cut the corners that cost" on your next piping job —specify and use Globe Welding Fittings, produced from Globe seamless steel tubes by the Globe Precision Process.

GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

Producers of Globe seamless stainless steel tubes — Gloweld Welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

For complete information on sizes and types send for Globe Welding Fittings Catalog.

GLOBE PRECISION PROCESS WELDING FITTINGS

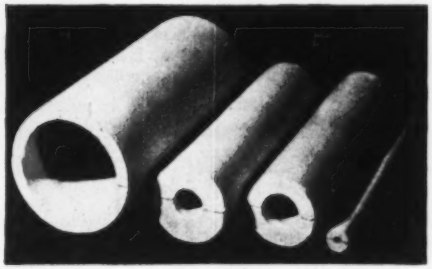
NOW!

One PIPE INSULATION COVERS TEMPERATURES FROM 200°F. to 1200°F.

KAYLO®
PIPE INSULATION

Here's a real advance in pipe insulation you should know about—the broad adaptability of Kaylo Pipe Insulation in serving a 1000° range of temperature requirements. To get a Kaylo Pipe Insulation sample and descriptive folder, fill in and send the coupon below. These are some of the reasons you'll be interested:

- Kaylo Pipe Insulation offers remarkable efficiency from 200° up through 1200°. It withstands effects of vapor and water.
- Simplified Dimensional Standards of thicknesses and diameters allow snug-fitting nesting of successive layers, when necessary—simplify installation and permit minimum inventories.
- Easy to handle and apply, this strong, lightweight insulation can be cut, scored and sawed with standard tools.
- The experiences of varied industries with millions of feet of Kaylo Pipe Insulation attest to its wide-range efficiency and long service capacity.



Kaylo Pipe Insulation is available in nominal thicknesses from 1 to 3 inches in 36-in. sections, for pipe sizes from ½ inch to 12 inches. Kaylo Insulation is also available in block and lagging form.

MAIL COUPON FOR KAYLO PIPE INSULATION SAMPLE AND DESCRIPTIVE FOLDER

This new folder tells you all about Kaylo Pipe Insulation—the available sizes and recommended thicknesses for various temperatures; physical characteristics; efficiencies, and heat losses.

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division **Toledo 1, Ohio**

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Gentlemen: Please send me a Kaylo Pipe Insulation sample and descriptive folder.

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CITY.....STATE.....

Is your air-conditioning equipment

OVERLOADED

with

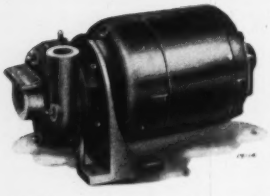
EXCESS H. P.?

Here's how you can cut first cost and power costs by specifying smaller, more efficient *I-R Motorpumps.*

Today, more than ever before, users of air conditioning equipment are looking for ways to *save*—not only on initial investment, but on operating costs as well. And they certainly don't want to pay for more horsepower than they need.

Take the pumps, for example. Why use a pump that requires a 2 h.p. motor when a 1½ h.p. I-R Motorpump may do the same job at so much lower cost? The higher efficiency and non-overloading characteristics of I-R Motorpumps permit you to cut your costs—and perhaps reduce the size and weight of your equipment as well. Their outstanding record for dependability under all types of operating conditions means more satisfied users—and more repeat orders.

Call your local I-R pump distributor or nearest Ingersoll-Rand branch office and have an experienced pump engineer show you how to save yourself *and* your customers money by using I-R Motorpumps engineered for the job. Prompt shipment from stock.



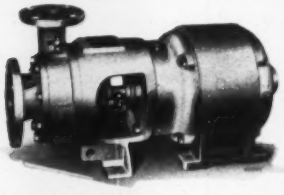
I-R MOTORPUMPS — Class KRVS

Single Stage, 5 to 125 gpm. Heads to 100 ft.

Suitable for 3, 5, and 7½ package units

These compact, high-efficiency, fractional hp Motorpumps require no special foundations, and may be mounted vertically, horizontally, or at any angle, provided the motor is not below the pump.

No drip pan is needed. A fool-proof mechanical shaft seal eliminates stuffing box leakage and requires little attention and maintenance.



I-R MOTORPUMPS — Class RV

Single Stage, 20 to 275 gpm. Heads to 500 ft.

For larger package units and engineered installations

These heavy-duty, completely self-contained units provide maximum efficiency for integral hp applications.

Features include—flexibility of mounting, ball-bearing-mounted oversize shaft, mechanically and hydraulically balanced impeller, and extra deep stuffing box which is easily accessible for packing.

THE CAMERON MOTOR PUMP
A PRODUCT OF

Ingersoll-Rand

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COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES

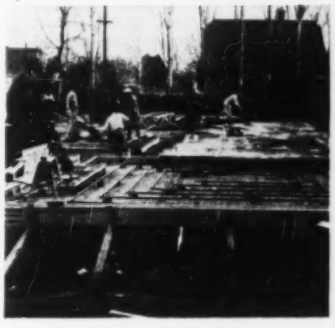
This is "Comfort Valley"...

Where Steel Pipe is first choice for Radiant Heating . . .

"In the comfort of a valley, home can seem 'a dream come true'," a poet once said . . . and his words are a perfect description of many a modern American home development. For what can make for more happy living, when the chill winds of winter blow, than the snug warmth of new, radiant heated homes in "Comfort Valleys" everywhere?

Radiant Heating systems in such homes are at their best, of course, when installed with durable, adaptable, economical steel pipe. You see, steel pipe's proved service record in conventional hot water and steam heating systems over more than 60 years would, alone, entitle it to first consideration. But, more than that, the *specific* piping requirements of the popular new Radiant installations are met in *every* particular by steel pipe. It's readily formed, easily welded, imparts structural strength, and importantly, has the same co-efficient of expansion as concrete, plaster and masonry. It's lower in cost, too, and is made to outlast the useful life of the building.

Already, as in conventional heating, more steel pipe is used for Radiant Heating than any other!

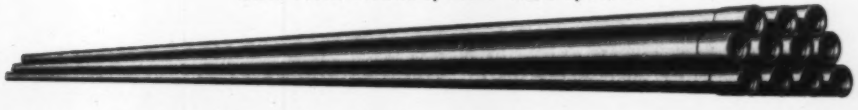


The inherent characteristics of steel pipe are perfectly "matched" to the installation requirements of Radiant Heating.

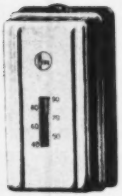
COMMITTEE ON STEEL PIPE RESEARCH

OF AMERICAN IRON AND STEEL INSTITUTE

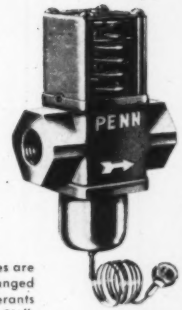
350 Fifth Avenue, New York 1, N. Y.



Penn 270 Series temperature and pressure controls incorporate 2-pole construction and a direct-reading calibrated scale which shows both cut-in and cut-out points.



Penn Unit Heater Thermostat features "heat anticipation" and a built-in "on-off" switch. Cooling Thermostats and Humidistats are also available in the Penn line.

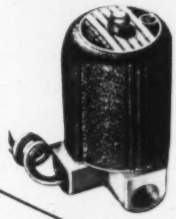


Series 246 Water Valves are built in threaded and flanged styles for all refrigerants and in sizes from ⅜" to 2½".

TRY 'EM!

then you'll use them on every refrigeration job

Penn Series 221 Solenoid Valves are direct acting and may be used with all non-corrosive refrigerants as well as for water, oil or air.

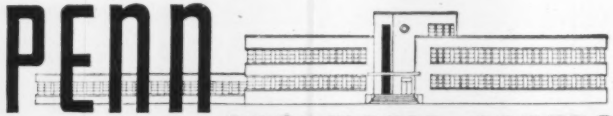


Penn Magnetic Line Starters are built in NEMA sizes 0, 1 and 1½ and are available as open-type models for control panels or with General Purpose enclosures.

There is a difference in automatic controls . . . a difference in the degree of their efficiency, dependability and long-life accuracy! And once you try PENN controls . . . you'll learn that their performance on the job is the strongest recommendation for using PENN on every air conditioning, refrigeration and space heating application.

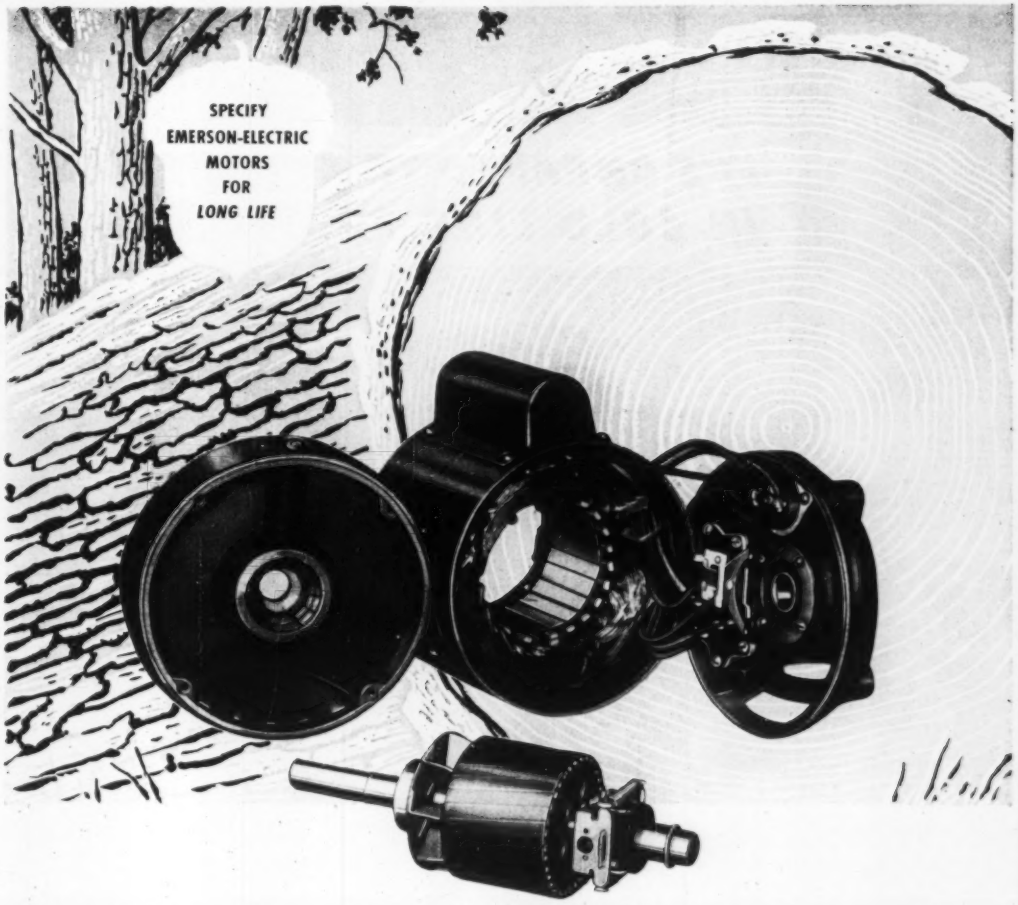
Featured in the air conditioning and refrigeration line is the famous 270 Series . . . the first and only control in these fields to have a load-carrying, two-pole contact structure. It gives you two switches in one! It controls multiple refrigeration systems . . . it controls two separate load circuits . . . it controls polyphase motors without the use of line starters (where protection is provided against single phasing).

Take the first step in trying these better controls. Get the *new* PENN Condensed Catalogs . . . one on heating and the other on refrigeration controls . . . they're FREE. Ask your wholesaler or write **Penn Electric Switch Co., Goshen, Ind.** Export Division: 15 E. 40th Street, New York 16, U.S.A. In Canada: Penn Controls, Ltd., Toronto, Ont.



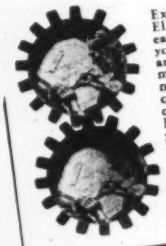
AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES



Sound to the core . . . to guard your reputation

Emerson-Electric's unique *Twin*gineering SERVICE solves your power problems



Experienced Emerson-Electric Engineers are eager to collaborate with your own staff in designing and providing the proper motor application to your new or improved appliance or equipment. Such collaboration—TWIN-GINEERING we call it—can save you costly engineering "back-tracking," and may suggest short cuts or improvements of great competitive benefit to your product. Write us today . . . there is no charge for this service.

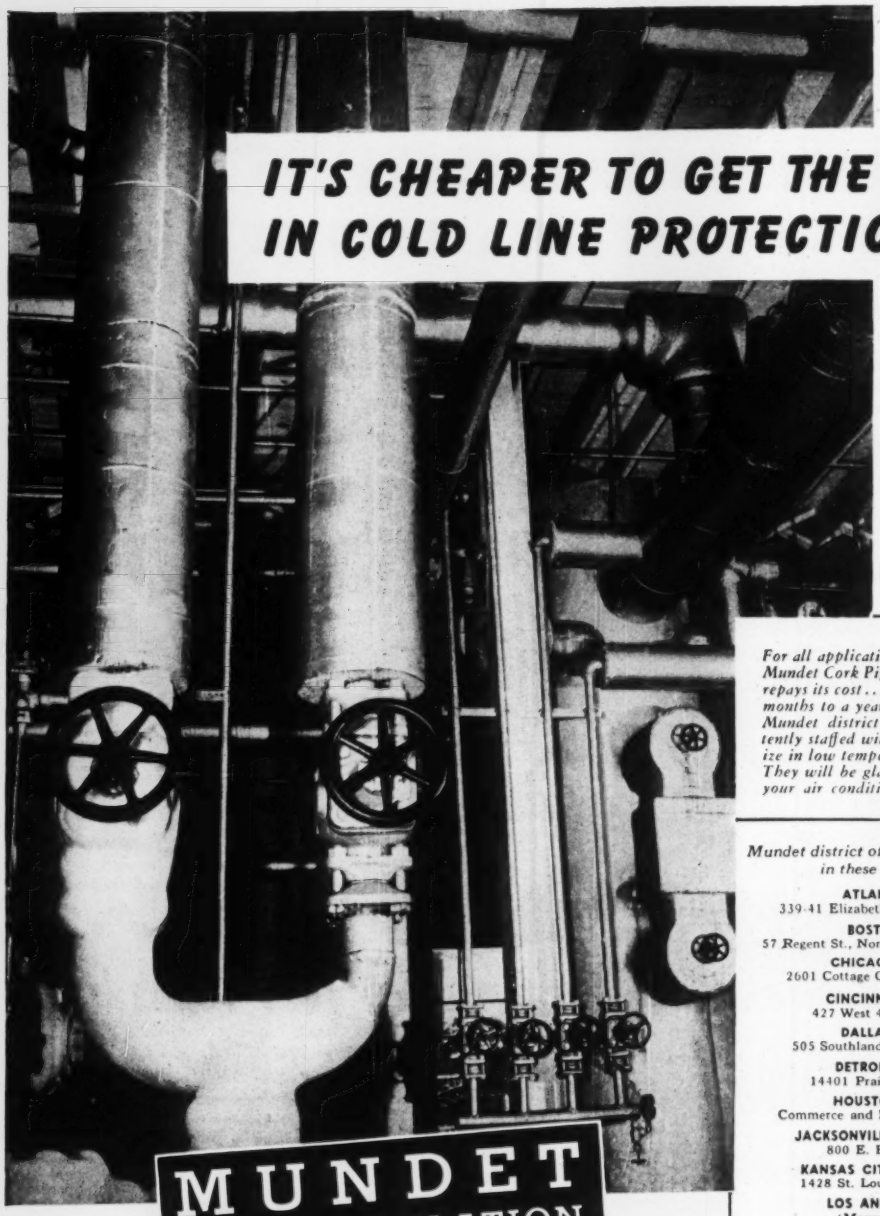
Do your products enjoy the ready acceptance they deserve?

The products you are producing today will determine your reputation in future years. Satisfactory service over a period of time is the decisive test. And so it is with Emerson-Electric Motors . . . sixty years of motor-building know-how have earned for Emerson-Electric the enviable reputation of consistently producing motors with sound engineering and design principles, sound construction—motors that are literally "sound to the core".

Scores of America's most reputable manufacturers recognize that their products are known by the service they perform. For this reason their products are powered by Emerson-Electric Motors . . . thus assured of years of dependable service. Your inquiry is invited as to how Emerson-Electric can guard the reputation of your product with its complete line of motors, 1/20 to 5 h.p.

THE EMERSON ELECTRIC MFG. CO.
ST. LOUIS 21, MO.

EMERSON ELECTRIC
MOTORS • FANS — APPLIANCES



IT'S CHEAPER TO GET THE BEST IN COLD LINE PROTECTION . . .

For all applications of refrigeration, Mundet Cork Pipe Covering quickly repays its cost . . . frequently within 8 months to a year of the installation. Mundet district offices are competently staffed with men who specialize in low temperature applications. They will be glad to help you solve your air conditioning problems.

MUNDET CORK INSULATION

Mundet Cork Pipe Covering provides the essentials of most effective insulation: low thermal conductivity; non-absorbence; sanitation and permanence. Write for specification information, heat loss charts and other helpful data. Inquiries receive prompt attention. Mundet Cork Corporation, Insulation Division, 7101 Tonnelle Ave., North Bergen, N. J.

CORK PIPE COVERING • CORKBOARD

Mundet district offices are located in these cities:

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339-41 Elizabeth Street, N.E.

BOSTON
57 Regent St., North Cambridge 40

CHICAGO 16
2601 Cottage Grove Avenue

CINCINNATI 2
427 West 4th Street

DALLAS 1
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DETROIT 21
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JACKSONVILLE 6, FLA.
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ST. LOUIS 4
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In Canada:
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Write us for name of our nearest representative if there is no Mundet office in your city.

Capable of handling either LOW or HIGH VELOCITIES*

RESEARCH with resultant performance data has developed and proved a line of new Multi-Velocity Air Filters . . . super-efficient air filters capable of handling either LOW or HIGH Velocities . . . in a single unit!

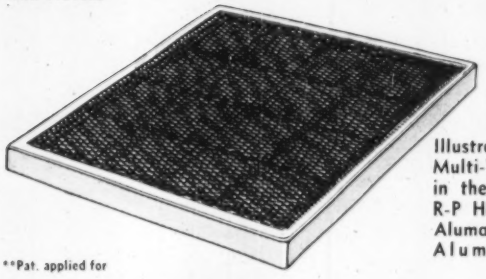
Features include . . . increased efficiency at all air velocities up to 550 feet per minute . . . lower restriction at all air velocities . . . increased depth loading . . . highest dirt holding capacity . . . exclusive non-clogging design . . . improved cleanability . . . PLUS . . .

Double Filtration.** The baffle pattern of the filter reduces in size of apertures through the first half of the filter . . . then starts anew with larger apertures and reduces again . . .

A Double Filtration Process!

Ask your distributor about this great line of R-P air filters. If you have not received your copy of our new portfolio R-P MULTI-VELOCITY AIR FILTERS, write today! Address Research Products Corp., Madison 10, Wis. Dept. H, Canadian Representative—Delhi Industries, Delhi, Ontario.

*MULTI-VELOCITY AIR FILTERS

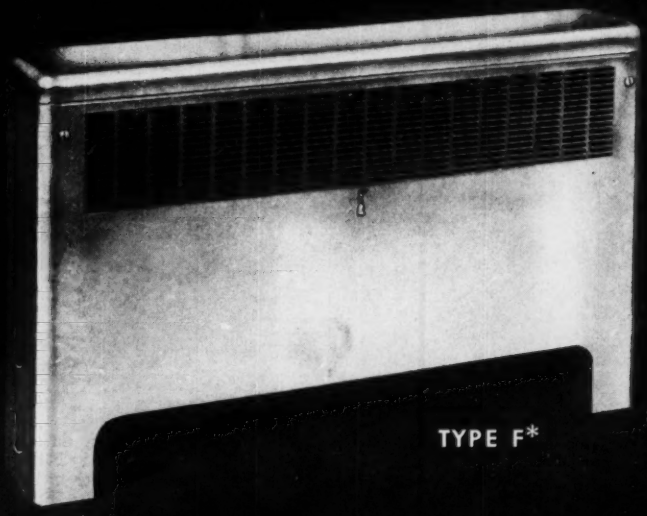


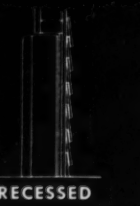
**Pat. applied for

Illustrated is the R-P Copper Industrial Multi-Velocity Filter. Also available in the Multi-Velocity line is the R-P Heavy Duty Industrial, R-P Alumaloy Industrial and R-P Alumaloy Grease Filter.

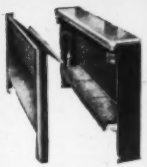
RP . . . PRODUCTS OF RESEARCH

WASHABLE AND REPLACEMENT AIR FILTERS • GREASE FILTERS • EVAPORATIVE COOLER MATERIALS





AIRTHERM
CONVECTORS
Designed for Quick, Easy Installation

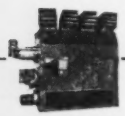


Airtherm Cabinet design permits quick, easy assembly. Type "F" available with lower inlet louvres.

Outstanding performance, plus quick, easy installation has led to an increasing preference for Airtherm Convectors in institutions, apartments, homes and schools. Ease of installation and increased customer satisfaction will enable you to make more money on each job when you use Airtherm Convectors. Try them—see for yourself.

*Also produced in Type "S", Sloping top; Type "W", Regular Front Wall Hung, and Type "FR" Flush Recessed Types.

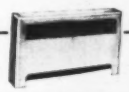
For Heating Satisfaction . . . Think First of **AIRTHERM**


Oil or Gas Direct Fired Heaters

Horizontal Type Unit Heaters

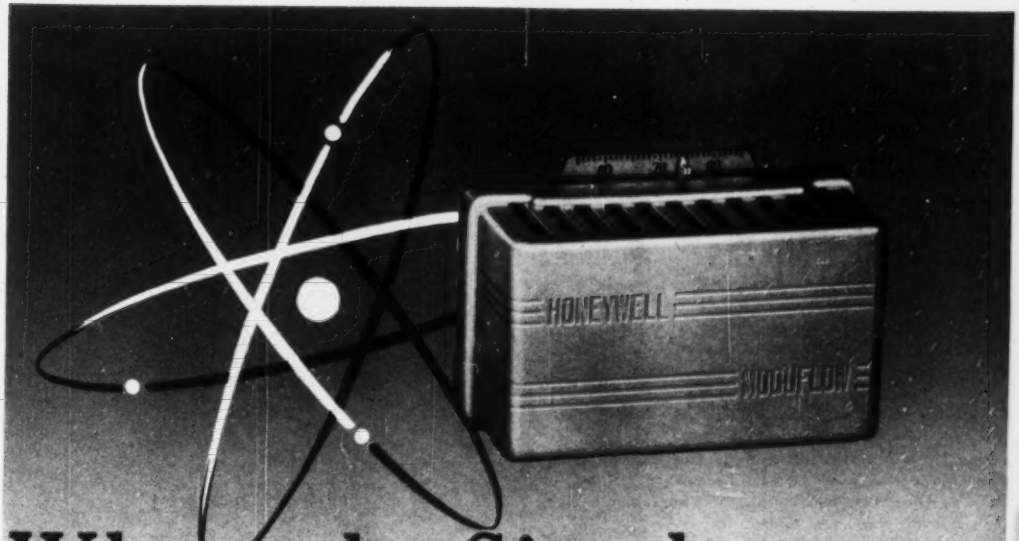
Vertical Type Unit Heaters

Centrifugal Fan Type Unit Heaters


Convectors

AIRTHERM MANUFACTURING COMPANY

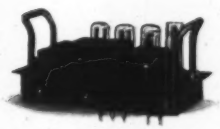
711 South Spring Avenue, St. Louis 10, Missouri



Where the Simplest is also the Best Honeywell Electronic Control

for Heating, Ventilating and Air Conditioning

Duct and immersion thermostat



Electronic relay

Modulating motor

HERE is everything you've wanted in an air conditioning, heating or ventilating control system — FASTER ACTION, MORE SENSITIVITY, GREATER ACCURACY, WIDE VERSATILITY, and ABSOLUTE SIMPLICITY.

Honeywell Electronic Control can sense and correct for a room temperature change almost before it happens! The speed of correction is limited only by the mechanical limitations of the air conditioning equipment. Temperatures are maintained within a fraction of a degree, with no overshooting, no waste of heating or cooling.

Yet, Honeywell Electronic Control is amazingly simple. One thermostat — with no moving parts — can control both heating and cooling. The system has less to wear out, less to get out of adjustment. Get all the details now. Phone the Honeywell office in your city or address a card to Minneapolis-Honeywell, Minneapolis 8, Minnesota. In Canada: Leaside, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
FIRST IN CONTROLS

77 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN: TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY

JENKINS PRACTICAL PIPING LAYOUTS 47

How to plan a

LOCALIZED HOT WATER SUPPLY USING STEAM-COLD WATER MIXERS

Generally small in size (up to 1" or 1½"), steam-cold water mixers are used to supply hot water economically to limited areas in industrial plants—washrooms, chemical processes, sterilizing, heat exchangers. The accompanying diagram shows the installation of two such mixers, with piping connections.

Strainers, in all lines to the mixers, prevent accumulation of scale and dirt, and thus prolong mixer life. Many install a steam trap at the end of the steam feed to drain the condensate away. This keeps live steam at the mixer inlet, and avoids lost time in arriving at desired hot water outlet temperatures.

The check valve recommended for this layout is the Fig. 92, Jenkins Regrinding Bronze Swing Check Valve. These checks prevent backup and mixing of the steam and cold water in the feed lines. The Fig. 92, with its 45° seat, will remain tight even at extremely low pressures, and its high tensile strength bronze disc can be reground easily without removing the valve from the line.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run*. Sold through leading Industrial Distributors.

Jenkins Bros., 80 White St., New York 13, N.Y.; Bridgeport, Conn.; Boston; Philadelphia; Chicago; San Francisco; Atlanta. Jenkins Bros., Ltd., Montreal.

A NEW BOOK OF PIPING LAYOUTS, Nos. 26-50 including above, is in preparation. Mail coupon to get your copy when ready.

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Reserve copy of New Piping Layout Book for

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Company .....

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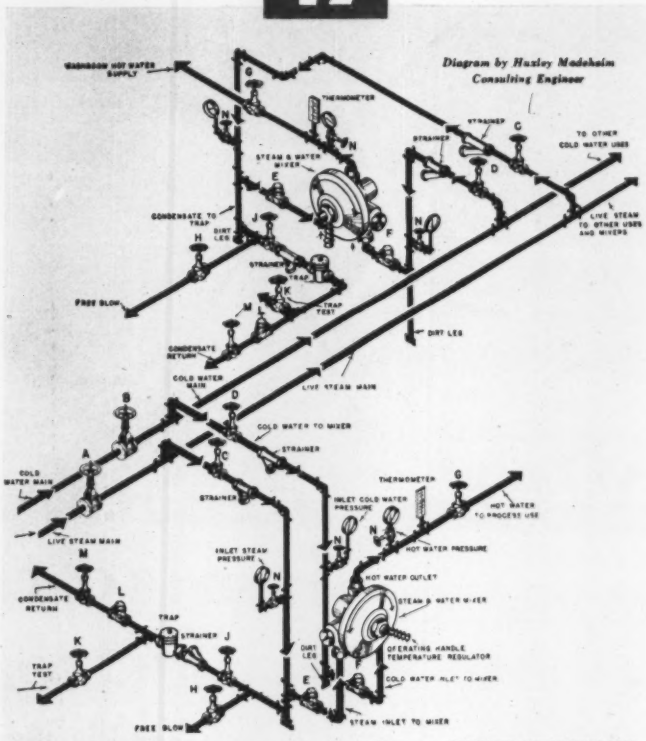

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VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog

CODE	QUAN.	JENKINS VALVES	SERVICE
A	1	Fig. 651 IBBM Gate	Steam Main Shutoff
B	1	Fig. 651 IBBM Gate	Cold Water Main Shutoff
C	2	Fig. 47 Bronze Gate	Steam Feed to Mixer Shutoff
D	2	Fig. 47 Bronze Gate	Cold Water Feed to Mixer Shutoff
E	2	Fig. 92 Bronze Swing Check	Prevent Backflow to Steam Main
F	2	Fig. 92 Bronze Swing Check	Prevent Backflow to Cold Water Main
G	2	Fig. 106A Bronze Globe	Control on Hot Water Outlet
H	2	Fig. 106A Bronze Globe	Emergency Free Blow on Condensate
J	2	Fig. 47 Bronze Gate	Condensate Trap Shutoff
K	2	Fig. 106A Bronze Globe	Trap Test
L	2	Fig. 92 Bronze Swing Check	Prevent Condensate Backflow
M	2	Fig. 47 Bronze Gate	Condensate Return Shutoff
N	6	Fig. 743 Bronze Needle	Pressure Gage Control

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK
Jenkins Bros.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1950 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

HPAC 4268—PACKAGED AIR CONDITIONERS—"Yorkaire" models 352 and 552 packaged air conditioners are equipped with a new "Atmostat" designed to provide improved control of humidity in conditioned spaces.

A v mounted coil of staggered tube and corrugated fin design is so arranged that under normal conditions refrigerant flows through both sides of the coil. During muggy or abnormally high humidity periods, a switch is turned to divert all the refrigerant to one side of the coil where it is "concentrated on removing the excess moisture from the air without reducing temperature below the comfort level". Automatic switch control is available.

Also featured is a new hermetic compressor unit using "Freon-22".

HPAC 4269—ALUMINUM FITTING—A new all-aluminum fitting for use with annealed aluminum tubing is offered by Scovill Mfg. Co., Waterbury 91, Conn. Designed to provide positive, permanent connections, it is recommended for the elimination of galvanic action between the fitting and the aluminum tubing.

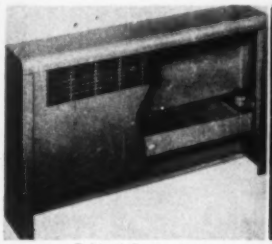
It is of the "Uniflare" design as used in the company's brass fittings and is a self-contained, two-piece unit, with a self-flaring feature. The body of the fitting contains a flaring cone, and the nut contains a thrust collar. One turn of the nut, says the manufacturer, is sufficient to shear off the collar, and further tightening clamps the collar onto the tube to form a seal which is said to be leakproof.

The entire fitting is anodized for corrosion resistance, and during the anodizing a blue color is added to the finish for identification purposes. Fittings are available in all standard shapes on a made-to-order basis for use with aluminum tubing 3/16 in. through ½ in. OD.

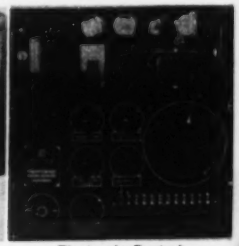
HPAC 4270—CABINET CONVECTORS—A complete line of cabinet convectors, including recessed, semi-recessed, free standing, or wall hung types has been developed by Rittling Corp., 1298 Niagara St., Buffalo 13.

Available in 4, 6, 8, and 10-in. depths (other than the semi-recessed style which is produced in 6, 8, and 10-in. depths) all units are produced in lengths of 4-in. increments from 16 to 64 in. Designed for use with steam or forced hot water systems, the heating elements have seamless copper tubes expanded into aluminum fins. Each header is equipped with top and bottom fittings for ease of installation.

All cabinets, according to the company, are made of heavy gage steel with front panels that are easily removed by hand, without the use of any tools, and are so designed that removal of the front panel does not break paint lines at the wall. Front panel perforations are designed for easy cleaning, and knockouts are provided for concealed piping hookups. Wall hung units have flat top and front outlet or sloping top with top outlet.



Cabinet Convector



Electronic Control

HPAC 4271—ELECTRONIC CONTROL—Electronic control instrument No. 077, developed by Brown Instruments Div., Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia 44, is an industrial control which is said to be sensitive to temperature changes as small as 0.1 deg.

The device is designed to control industrial processing temperatures between –20 F and 300 F and is said to be immune to vibration, dust, and dampness. It may be used with the company's indicating or recording instruments.

Operating on the principle that the resistance of a wire-wound sensing element varies in proportion to the temperature of the medium, the sensing element forms one leg of a Wheatstone bridge circuit so that a temperature change causes the bridge to become unbalanced and permits current flow. Electrical unbalance of the bridge is imposed on the electronic amplifier which amplifies and detects the direction of unbalance to operate either of two

FOR YOUR CONVENIENCE [2-50]

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

4268 4269 4270 4271 4272 4273 4274 4275 4276 4277
4278 4279 4280 4281 4282 4283 4284 4285 4286 4287
7534 7535 7536 7537 7538 7539 7540 7541 7542 7543
7544 7545 7546 7547 7548 7549 7550 7551 7552 7553
7554 7555 7556 7557 7558 7559 7560 7561 7562 7563

Name..... Title.....
Company .....
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City..... Zone..... State.....

ALCO

"T" SERIES THERMO VALVES

Simple "Come-Apart" Construction

1. POWER ELEMENT
Automatic-hydrogen welded for maximum life.

2. MINIMUM MOVING PARTS
Assures fast valve action.

IT'S EASY TO REMOVE THE CAGE

3. AVOIDS COSTLY VALVE CHANGES
Capacity can be varied by changing the cage. No separate pins or seats.

4. INTERNAL PARTS
Corrosion resistant, brass and stainless steel.

5. EASY TO SERVICE
Valves can be cleaned and parts replaced without breaking line connections.

ALCO has Refrigeration under Control

25 YEARS ALCO

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

SEE YOUR ALCO WHOLESALER

ALCO VALVE CO.

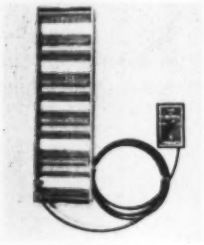
861 KINGSLAND AVE. • ST. LOUIS 5, MO.

4135

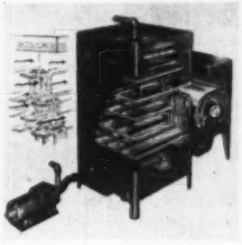
output relays, according to the direction of temperature change. The two relays control a motor.

HPAC 4272—GRILLE WITH VOLUME CONTROL—For ventilating and air conditioning systems in modern schools and other public buildings, the new "Uni-Flo" grille with integral volume control is said to combine efficient, draftless air distribution and regulation of air volume in a single unit. The manufacturer is Barber-Colman Co., Rockford, Ill.

Air volume and direction are regulated by tamperproof adjustments accessible from the grille face. For duct access and for cleaning and redecorating without damaging wall surface, removable cores are provided. Grilles are said to have a large free area for low pressure drop and low noise level. They are supplied in a gray prime coat or in a wide selection of electroplated metal finishes.



Air Grille



Cooling Tower

HPAC 4273—COOLING TOWERS—A new type E series of induced draft cooling towers for use with small, packaged water cooled air conditioning and refrigeration condensing units has been developed by Binks Mfg. Co., 3122 Carroll Ave., Chicago 12.

The tower is designed to eliminate the use of nozzles and all internal piping, yet to provide excellent cooling capacity. It is said to be exceptionally quiet in operation and compact. Units are shipped assembled except for the air propulsion unit which is separate. Galvanized steel is used throughout and towers are available in a wide range of capacities up to 36 tons.

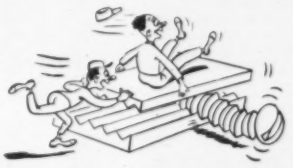
Warm water from the condenser of the refrigerating unit is delivered to a water diffusion pan on top of the tower. The water enters the cooling chamber of the unit through perforations in the floor of the diffusion pan. Cascade type deck surfaces are used to break the fall of the water and cause "filming action". A squirrel cage blower draws air through the tower.

HPAC 4274—NEW AIR CONDITIONING UNITS—The 1950 line of dealer equipment of Carrier Corp., Syracuse, N.Y., includes 47 new models, of which 27 are units of types and sizes not previously offered by the firm.

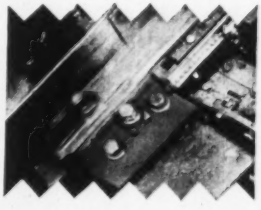
Six room air conditioner models have been completely redesigned, with three new sizes added so that the line consists of windowsill models of ½, ¾, and 1 hp and console types of ¾, 1, and 1½ hp. Self contained conditioners have been expanded from three to five models, 3, 5, 7½, 10, and 15 hp, and the new cooling tower, operated by a water driven turbine drive, is offered in four models from 5 to 15 tons capacity. Five new models of system "Weathermakers" include two additions of

ELCO Screws

ELCO ROLL THREADING PUTS QUALITY IN "THE SCREWS YOU LIKE TO USE"



Our pals here give you the idea — you roll the screw blank between grooved dies and you get threads. Easy? Well . . . First, the dies have to be *right*, or you get irregular, rough, or shallow threads. Second, you need *know-how* to set your machines for different sizes and materials, or you get poor results or inadequate production. Third, you need *skill* in figuring the blank, or the screws don't come out the way they should. Roll threading, done right, has the distinction of retaining the smooth, compressed, toughened surface inherent in the raw drawn wire. If you want top quality, buy ELCO roll-threaded products.



Close-up of a Fast Roll

A quick, smooth swish — 100 swishes a minute — and for every swish the *whole job* of threading (in this case) a 1/4-20 x 1-1/2 machine screw. Clean, smooth, accurate threads, too — ELCO threads.

ELCO TOOL & SCREW CORPORATION
1920 BROADWAY · ROCKFORD, ILLINOIS

ACCURATE PIPE CUTS
Quick and Easy

"Anybody does better work with better tools—If they come any better than RIDGID I've never seen 'em."
RIDGID
NO. 2 HEAVY DUTY
1/8 TO 2"

RIDGID Cutters roll right through all kinds of pipe and conduit

● It's really a cinch to cut pipe extra fast with the popular efficiency-balanced RIDGID cutter. Thin heat-treated tool-steel blade leaves practically no burr. Every cutter factory-tested to make sure it tracks perfectly. Your choice of five sizes to 6" pipe; four-wheel cutters to 4." Choose the favorite of men who know fine tools — buy RIDGID cutters at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

larger capacities so that sizes now range from 5 to 75 tons. Two new room units, ¾ and 1½ hp, for conditioning rooms from installed refrigeration sources have been added. According to the company, these are designed for certain markets where it is not practical to use the firm's "Conduit" system.

Also new are six models of belt driven condensing units in 5, 7½, 10, 15, 25, and 40 hp sizes.

HPAC 4275 — CENTRIFUGAL PUMPS — Marlow Pumps, Ridgewood, N. J., has added a new line of straight centrifugal pumps for use primarily on installations with flooded suctions.

Designated types SC and SL, they are offered in close or long coupled construction, in 1 to 4 in. sizes, and with capacities from 10 to 1000 gpm. Features include a sealing ring at the suction inlet and ball bearings sealed against dirt and moisture. The stuffing box, an integral part of the casing, is designed to contain a liberal number of packing rings. Where desired, a self lubricating shaft seal is available. The impeller is of the enclosed type and the volute, regularly of cast iron, can be obtained in bronze, nickel, stainless steel, or other special alloys. The steel impeller shaft is protected by a bronze sleeve at the stuffing box.

Motors, from ½ to 30 hp, are splash protected and are equipped with moisture resistant insulation. Explosion-proof or fully enclosed motors are also available.

Above: Centrifugal Pump
Right: Solenoid Gas Valve

HPAC 4276*—SOLENOID GAS VALVE—A new solenoid gas valve, the series 3500, has been introduced by the controls division of Perfex Corp., 500 W. Oklahoma Ave., Milwaukee 7. It is designed for use on space heaters, unit heaters, central heating equipment, conversion burners, etc.

A feature is the fact that one valve can be used for all gases, including liquefied petroleum gas. Unusual closing pressure is said to be achieved by the combined force of a compression spring pushing down on the plunger, a heavy plunger assembly, and the pressure of the gas itself. Positive shutoff, according to the firm, is assured by a valve seat made of special synthetic material—"not as soft as leather, but more flexible and resilient than metal-to-metal contact". The special material used is said to be unaffected by any gas used in heating.

At present the valve is available in low and line voltage models in ½, ¾, and 1 in. sizes, with or without a manual opening device.

HPAC 4277—PACKAGED STEAM GENERATOR—The "McKee Gas-Fired Scotch Steam Pak" is a packaged steam generator of the horizontal tube type available in

Two great names join forces!

EFFECTIVE January 6, 1950, American Air Filter Company, Inc., Louisville, Kentucky, and The Herman Nelson Corporation, Moline, Ill., merged their interests, with the former company remaining as the surviving corporation.

Each organization will continue to operate from its respective headquarters, with present management and field representation.

In the future, industry may expect even still finer products and services from these two recognized leaders in the field of heating, ventilating, air filtering and dust control equipment.

American Air Filter Company, Inc.

LOUISVILLE 8, KENTUCKY • MOLINE, ILLINOIS

INDEPENDENT

"Fabrikated" WALL GRILLES for Commercial Installations

PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A

UP OR DOWN

RIGHT OR LEFT

311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

Write for new Catalog No. 48—gives schedule of sizes, details and prices.

Always Leading — Always Progressing

*Reg. U. S. Pat. Off.

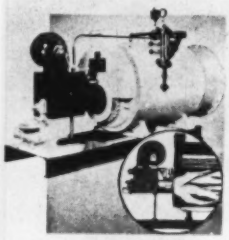
THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET · CLEVELAND, OHIO

nine sizes from 12 to 100 hp. from Eclipse Fuel Engineering Co., 767 S. Main St., Rockford, Ill.

Said to combine the advantages of gas firing and the Scotch or vertical tube design, it incorporates a shell which is a horizontal steel cylinder. Inside of this is another steel cylinder which is the furnace in which gas is burned. At the back of the furnace is an insulated chamber from which return tubes conduct gases back the length of the boiler.

On units up to and including 30 hp, firing is done with a self contained combustion unit incorporating a blower and steam, gas, and safety controls. On the larger units, air from a centrifugal blower flows through a jet in the proportional mixer, used to create a suction which pulls in gas from the governor. Electronic flame failure protection is furnished on all units.



Steam Generator

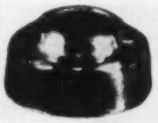
Air Filter

HPAC 4278—THROW AWAY TYPE AIR FILTER—A new refill type glass fiber air filter is available in a reusable metal frame for all types of forced air heating, ventilating, and air conditioning systems. To industrial and commercial users, whose systems include banks of filters, there is an appreciable economy in saving the frames when the filters are changed, according to Glasfloss Corp., Commerce Bldg., New York 17.

When the filter pack has obtained its capacity dust load, the light metal frame is removed from the bank, unfastened, and the used pack discarded. A fresh pack is inserted, the frame retaped with regular industrial tape, and the unit returned to the filter bank.

The manufacturer points out that the filter pads are made of unusually fine, soft glass fibers so that they are safe and easy to handle. The fine diameter of the fibers is also said to allow exceptional air passage.

HPAC 4279—FLOOR, CEILING PLATES FOR PIPE—Ritter Pattern & Casting Co., Inc., 230 Canal St., New York 13, is now manufacturing a new type floor and ceiling plate for use with piping. It incorporates a safety locking device to prevent accidental opening of the split plates after installation. The new feature is the addition of a lug below the set screw used to secure the plate to the pipe. Plates are made in cast iron and cast brass from $\frac{1}{8}$ in. to 20 in. pipe size.

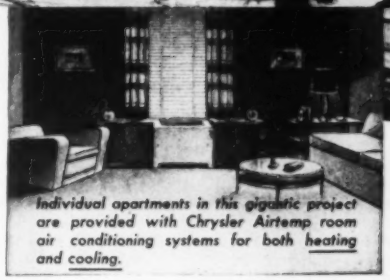


Also recently developed is a jack type adjustable tunnel stanchion now being used in tunnels carrying piping from central heating plants to various buildings. It is said to permit quick and simple installation of uprights because pipe can be cut with sufficient clearance at the factory or

TO BE TRULY MODERN A BUILDING MUST BE AIR CONDITIONED

Year 'Round Comfort by Chrysler Airtemp

The Berkshire Apartments, 4201 Massachusetts Avenue, Washington, D. C. Builder: Standard Construction Company, Washington, D. C., Wm. Magazine, President, Charles Kaplan, Secretary. Architects: Corning & Moore. Consultants to Builder: Wm. Bornstein & Son, Inc., Chrysler Airtemp Dealer. Mechanical & Electrical Engineers: General Engineering Associates.



Individual apartments in this gigantic project are provided with Chrysler Airtemp room air conditioning systems for both heating and cooling.

Chrysler Airtemp Individual Room Air Conditioners Selected for Washington's Largest and Finest Apartment Building

In Washington's new Berkshire Apartments—believed to be the largest single apartment building in the United States—Chrysler Airtemp Air Conditioning units were selected due to their attractive and compact design; their quiet, automatic and dependable operation. Here over 1000 tons of Chrysler Airtemp refrigeration and water cooling equipment—using 1350 individual room units—is now being installed.

Perhaps you, too, are planning new construction or the modernization of an existing building. If you are, Chrysler Airtemp offers through its nationwide dealer organization or regional offices in principal cities the services of highly-trained field engineers to help select the most efficient air conditioning systems for your specific job. And when desired, Airtemp Construction Corporation—wholly owned subsidiary of Chrysler Corporation—will see the entire job through to completion, including supervision of field operations.

For additional information relative to Chrysler Airtemp's engineering services, send coupon today.

3 BASIC SYSTEMS TO MEET EVERY BUILDING NEED

CENTRAL SYSTEMS • **"UNITEMP" SYSTEMS** • **INDIVIDUAL ROOM UNIT SYSTEMS**

Chrysler Airtemp

AIR CONDITIONING • HEATING
COMMERCIAL REFRIGERATION

AIRTEMP DIVISION OF CHRYSLER CORPORATION, DAYTON 1, OHIO

AIRTEMP DIVISION OF CHRYSLER CORPORATION
Dayton 1, Ohio HP&AC-2-50

We would like to consult one of your field engineers regarding our air conditioning problems.

Name_____

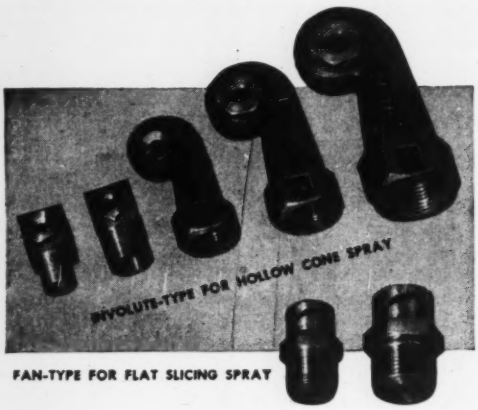
Address_____

City_____ Zone____ State_____

for • SPRAYING
• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

YARWAY

SPRAY NOZZLES



FAN-TYPE FOR FLAT SLICING SPRAY

Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

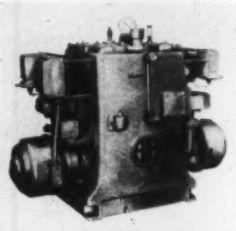
Thousands in use. Write for Bulletin N-616.

YARNALL-WARING COMPANY
107 Mermaid Avenue Philadelphia 18, Pa.

on the job without threading ends. The jack screw has a movement of approximately 2 in. and is made to take 2, 2½, and 3 in. upright pipe. Stanchions are offered complete with saddle brackets and rollers which are used to support piping.

HPAC 4280—VACUUM PUMP—Designed for economy of maintenance and space saving, the model VE heating vacuum pump is now in production at the plant of American Hydrovac, Inc., 290 Scholes St., Brooklyn 6.

It is a combination condensate return and vacuum pump, using but one centrifugal type pump for both functions, with no close fitting revolving parts. Vacuum is produced by a water jet venturi system. All parts, says the company, are easily accessible and the unit is of cast iron with bronze fittings throughout. A positive pressure on the mechanical seal of the pump is used to eliminate air leakage. Units are available in single and duplex types from 5000 to 25,000 EDR. Larger sizes in other models are also offered.



Vacuum Pump

Stop Valve

HPAC 4281—FORGED STEEL STOP VALVES—A new line of forged steel stop valves built by Edward Valves, Inc., East Chicago, Ind., is recommended for almost any service where small outside screw and yolk steel globe or angle valves are used. Identified as the Fig. 444 series, they are designed to fill the need for steel stop valves with wide applicability, good service characteristics, ease of repacking, and a relatively small pressure loss.

Swing bolted packing glands and large packing chambers, says the company, make any necessary repacking simple and interchangeability of parts reduces maintenance inventories. Bronze yoke bushings are used to prevent galling or freezing of the stem.

Constructed of drop forged steel, they are available with bolted or union bonnets in sizes ¼ in. through 2 in. and with screwed or socket welding ends. Built of carbon or chromium molybdenum steel for two ranges of service conditions, they are rated for 600 psi at 900 F and 1500 psi at 850 F for steam, oil, and gas service.

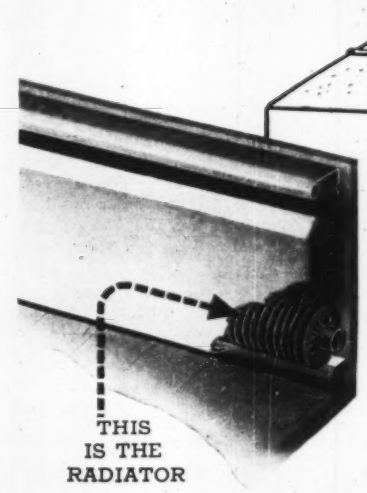
HPAC 4282—GASKET CUTTER—Disks, gaskets, and other similar cuttings (down to ¼ in. diameter), straight strips, and curves of any shape are said to be easily cut in pliable sheet materials with a new gasket cutting instrument developed by Zimmerman Packing Co., 2768 Highland Ave., Cincinnati 12.

A razor-sharp blade protrudes from a molded plastic body which is either rotated on a pivot or drawn across the material to be cut.

CHECK THIS MONEY SAVING PACKAGE!!!

"FLOORLEVEL"

HOT WATER BASEBOARD RADIATION



A COMPLETE INSTALLATION
in ONE money saving package

EASY TO HANDLE!
EASY TO STORE!
EASY TO SELL!
EASY TO INSTALL!

DE-AIRATOR TANK

"J" Series
BOILER-BURNER UNIT

THE COMPLETE FLOORLEVEL PACKAGE is packed in 3 cartons: (1) Heating elements, (2) Baseboard front panel and top moulding, (3) All miscellaneous fittings . . . Packaged in 6 different sizes for 200, 233, 263, 300, 333 & 366 sq. ft. radiation . . . for all size homes. *Designed for use with all types of hot water heating systems.* Circulators, flow valves and controls in required sizes.

THE DE-AIRATOR TANK UNIT is specially designed for *positive elimination of air* in hot water systems . . . Also acts as an expansion tank. Available for use with the following size installations: 500, 1000, 1500 sq. ft. of radiation.

Send for SPECIFICATION 56-E

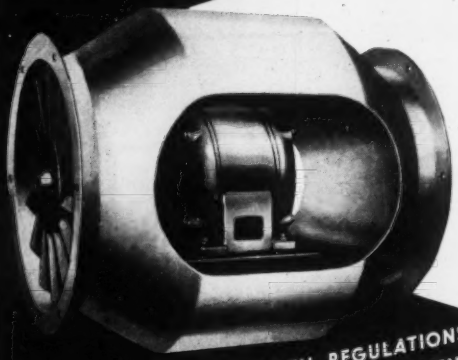
Since 1923

GENERAL Automatic

General Automatic Products Corp., 2300 Sinclair Lane, Baltimore 13, Md.
(Formerly General Oil Burner Corp.)

FOR EXHAUSTING DANGEROUS FUMES

...INSTALL DeBOTHEZAT BIFURCATOR FANS



COMPLY WITH STATE HEALTH REGULATIONS
PROTECT YOUR EMPLOYEES AND EQUIPMENT

DeBothezat Bifurcator Fans are specially designed for exhausting toxic, inflammable or explosive fumes. These direct drive fans have their motor mounted in a separate chamber. Destructive fumes are by-passed (bifurcated) around the motor, which remains cool, clean and easily accessible.

Bifurcator Fans can be installed at any angle. They install just like a section of ductwork, requiring no special platforms or supports. Available in a wide range of sizes with capacities from 1090 to 43,200 cubic feet of air per minute.

Send for Free Catalog

For selection of the right Bifurcator for a job, capacities, dimensions and specifications, send for free, illustrated Bifurcator catalog.

NEW BULLETIN ALSO AVAILABLE ON SPECIAL INDUCED DRAFT BIFURCATORS FOR BOILERS.

DE BOTHEZAT FANS DIVISION, Dept. H-14
AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS.

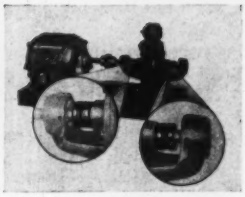
Please send Bifurcator Catalog without obligation.

Firm _____

Address _____

City _____ State _____

Sender's Name _____



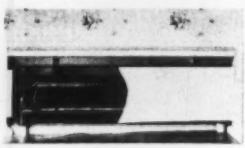
Above: Condensate, Feed Pump
Left: Gasket Cutter

HPAC 4283—CONDENSATE, BOILER FEED PUMP— Designed for maintenance free operation, the new "Master-Bilt" condensate and boiler feed pump is offered by Fred H. Schaub Engineering Co., Inc., 2110 S. Marshall Blvd., Chicago 23.

Chief features are "Fleximatic" mechanical seals (in lieu of packing) and permanently lubricated ball bearings. The seal is said to incorporate automatic adjustment of seal face tension proportional to internal pump pressure and to accommodate nominal axial misalignment. In addition, the company states that the seal may be run dry for several hours, if necessary, without burning the seal faces.

Normal life expectancy of the mechanical seal is said to be two years.

HPAC 4284 — BASEBOARD CONVECTOR** — The new "Baseline" convector of Ideal Plumbing Mfg. Corp., 927 15th St., N. W., Washington 5, D.C., is designed so that either a single or double ¾ in. ID copper finned core may be used, depending on heating requirements.



According to the manufacturer, a second core may be added to a single core installation at a later date without damage to walls, woodwork, or the outside baseboard covers. Two cores, two pipes, or a core and a pipe can be installed in the brackets furnished. This is said to make practical the supply and return at one end, one at each end, or at any point in between.

Heat control dampers are used to provide individual room control and the damper acts as a heat deflector, all air leaving from the front of the unit.

These convectors, which may be installed flush or recessed, are offered in 4, 5, 6, or 8 ft lengths.

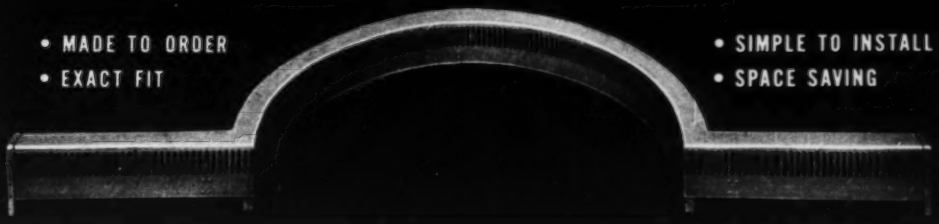
HPAC 4285—BRONZE VALVES—A new line of 150 lb "Hancock" bronze valves, with 500 Brinell hardness stainless steel seats and discs and a diaphragm construction said to be exceptionally strong, has been developed by Manning, Maxwell & Moore, Inc., Watertown 72, Mass.

Valves are manufactured in sizes of ¼ through 2 in. and are available in globe and angle types with screwed ends. They are designed for pressures up to 150 psi saturated steam or 300 psi nonshock cold water, oil, or gas.

AUTO-RAD CIRCULAR CONVECTORS

AN ENGINEERING TRIUMPH

- MADE TO ORDER
- EXACT FIT
- SIMPLE TO INSTALL
- SPACE SAVING

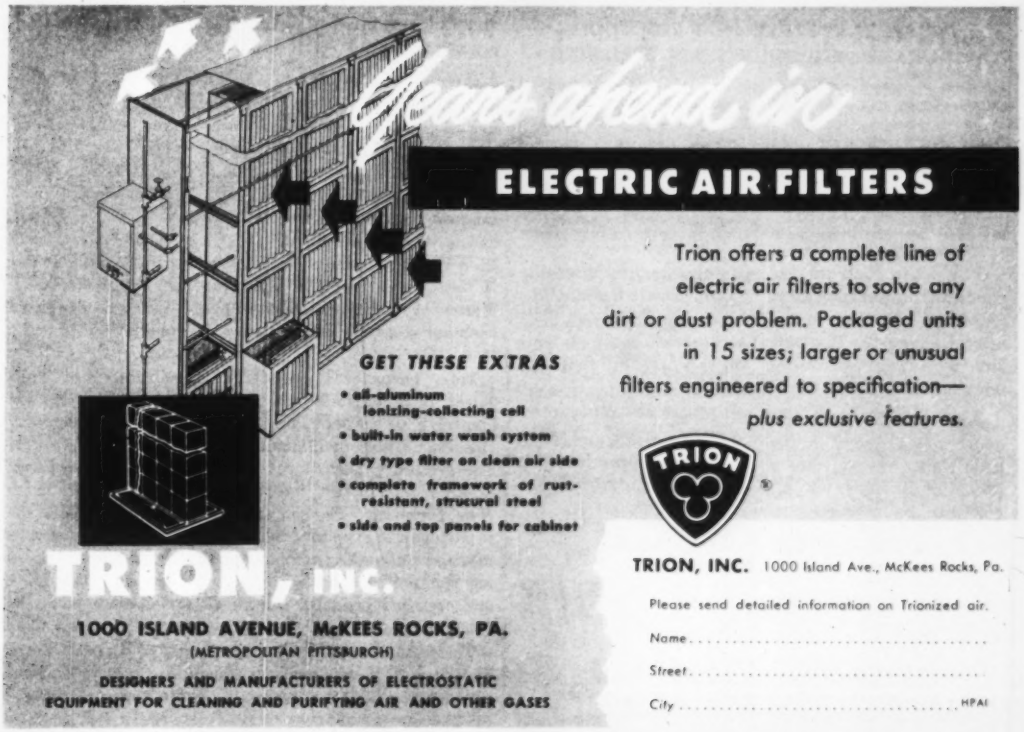


AUTO-RAD FLEXIBILITY IS PROVEN

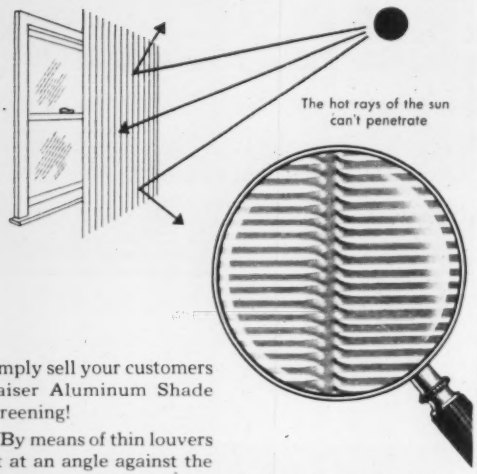
The many possible applications of AUTO-RAD BASEBOARD CONVECTORS is proven by the development of Circular Convectors. Convectors can now be furnished to follow the contour of rooms, circular or rectangular. Auto-Rad Circular Convectors are made in any outside radius larger than 5' 3" (10' 6" circle) in heights of 7" containing one row of radiation. This convector is particularly adaptable to residential installations. These circular convectors are also made up to 45" high containing up to 8 rows of radiation for installations in hospitals, railway stations and other public buildings. Prices are quoted upon receipt of prints or templates. Write for the Auto-Rad layout sheet form AR-101 and Bulletin No. 50.

AUTO RADIATOR SPECIALTY CO.
ESTABLISHED 1920

3535 FILLMORE STREET
CHICAGO 24, ILL.


Leads ahead in
ELECTRIC AIR FILTERS
GET THESE EXTRAS
• all-aluminum ionizing-collecting cell
• built-in water wash system
• dry type filter on clean air side
• complete framework of rust-resistant, structural steel
• side and top panels for cabinet
Trion offers a complete line of electric air filters to solve any dirt or dust problem. Packaged units in 15 sizes; larger or unusual filters engineered to specification—plus exclusive features.
TRION
TRION, INC.
1000 ISLAND AVENUE, McKEES ROCKS, PA.
(METROPOLITAN PITTSBURGH)
DESIGNERS AND MANUFACTURERS OF ELECTROSTATIC EQUIPMENT FOR CLEANING AND PURIFYING AIR AND OTHER GASES
TRION, INC. 1000 Island Ave., McKees Rocks, Pa.
Please send detailed information on Trionized air.
Name
Street
City
HPAI

New, easy way to sell air conditioning units:



Simply sell your customers Kaiser Aluminum Shade Screening!

By means of thin louvers set at an angle against the direct rays of the sun, Kaiser Aluminum Shade Screening cuts room temperatures as much as 15°.

TYPICAL EXAMPLE OF HEAT REDUCTION WITH KAISER ALUMINUM SHADE SCREENING

Figuring 23 west windows 3½'x6'. Total area 3½'x6'x23 = 463 sq. ft. taking a 3:00 P.M. peak load, during midsummer at 40° Latitude.

	B. T. Us.
Sun load passing through unshaded windows	82,200
Sun load passing through Shade Screen	8,220
Reduced by	73,980
Refrigeration savings	6.15 tons

Thus, the load on air conditioning equipment is lessened—which reduces operating costs. You sell smaller air conditioning units *to far more customers!*

Almost every home, every office, every industrial building becomes a potential customer for air conditioning . . . *when you combine it with Kaiser Aluminum Shade Screening!*

Put this high profit combination to work for you! Write today for free AIA file and name of your nearest jobber or contractor.

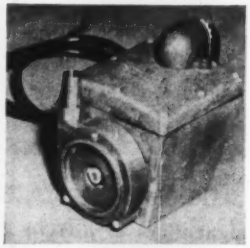
Kaiser Aluminum Shade Screening is produced by Kaiser Aluminum & Chemical Corporation.

Kaiser Aluminum

SHADE SCREENING

Sold by Kaiser Aluminum & Chemical Sales, Inc., Kaiser Building, Oakland 12, California

HPAC 4286—VAPORIZER PUMP—Little Giant vaporizer Co., Inc., P.O. Box 3535, Oklahoma City, is offering a new vaporizer pump which is hermetically sealed in oil so that it may be used for submerged operation. Designed to break water into a fine spray, it is recommended for use in evaporative coolers, condensate removal for refrigerated coolers, oil coolant pumps, etc. According to the manufacturer, it is ideal for use in humidifying air and in other spray applications.



Vaporizer Pump

Wrenches

HPAC 4287—BENT HANDLE WRENCHES—With the introduction of 45 and 90 deg bent handle construction wrenches in both carbon and alloy steels, J. H. Williams & Co., 400 Vulcan St., Buffalo 7, offers a wide range of sizes and styles in construction pattern wrenches.

The new wrenches are designed to facilitate work in close quarters where maximum accessibility and leverage are required and are recommended for flange and pipe line work in refineries, chemical plants, and industries using processing equipment. Openings are from ⅞ to 2 in.

WE HEAR THAT . . . .

The merger of **American Air Filter Co., Inc.**, Louisville, Ky., and **Herman Nelson Corp.**, Moline, Ill., became effective last month. The Nelson Corp. is now being operated as the **Herman Nelson Div., American Air Filter Co., Inc.** and will continue to maintain its headquarters and facilities in Moline. The principal offices and headquarters of the new organization will be in Louisville. W. G. Frank, executive vice president, and Richard H. Nelson have been elected directors of the combined firm and Richard H. Nelson and Robert W. Nelson are vice presidents. E. G. Mason, of the Herman Nelson division, has been elected assistant secretary and assistant treasurer.

Tube Turns of Canada, Ltd., a subsidiary of Tube Turns, Inc., Louisville, was recently granted its Dominion charter and is establishing a modern plant in Chatham, Ontario, for the manufacture of welding fittings..... The general export offices of **Baker Refrigeration Corp.**, South Windham, Me., have been moved to 103 Park Ave., New York City. The relocation is designed to enable the department to keep in closer contact with foreign distributors and forwarding companies. An application engineering staff will be headquartered at the New York office and company products will be displayed.

The 1950 line of dealer equipment of **Carrier Corp.**, Syracuse, N. Y., was recently unveiled at a six-hour stage presentation for 400 dealers and distributors gathered in Chicago. Similar meetings followed in Dallas, New

Orleans, Atlanta, and Atlantic City. Some 47 new models are included in the line, of which 27 are units of types and sizes not previously offered..... **Warren Webster & Co.**, Camden, N. J., honored 63 officials and employees of its Quarter Century Club at a recent luncheon. All of the members present had completed 25 years or more of service with the firm, including nine new members. Among the new members admitted to the club were Warren Webster, Jr. president, and Harold F. Marshall, sales promotion and advertising manager.

With the development of an exclusive flat-metal continuous casting process, which produces large rectangular section brass bars, **Scovill Mfg. Co.**, Waterbury, Conn., has placed in operation a $10 million continuous strip mill which is said to be capable of producing the heaviest cold rolled and nonwelded brass coils in the industry. While the "heart" of the mill is the continuous flat-metal casting machine, a completely new cold rolling mill is geared to the capacity of the machine in order to produce finished strip and sheet.

Industrial instrumentation training school schedules to be conducted during the first six months of this year by **Brown Instruments Div., Minneapolis-Honeywell Regulator Co.**, Philadelphia, will include four short courses of five weeks each and one long course of 13 weeks. In addition to the short courses for customers' men, which started last month and which will continue during March, May, and June, intensive courses will be held for specific industries. The comprehensive 13-weeks course starts on February 27. Classes will be held in Philadelphia.

Fifty students from distributor organizations, representing five foreign countries and 14 states, have been graduated from the Institute of Refrigeration and Air Conditioning of **York Corp.**, York, Pa. Members of the group completed a six-weeks course in commercial sales engineering or commercial service training. At the West York plant, engineers from the firm's home office and district territories throughout the country recently attended a district engineers meeting.

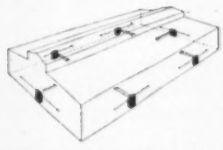
Employees of the Middletown, Pa., steel boiler plant of **National Radiator Co.**, Johnstown, Pa., have been presented with a National Safety Council plaque for working a full year without a lost time accident. This is the third time in recent years that these workers have received this recognition for a perfect safety record..... Construction of an addition to the Chicago plant of **Joseph T. Ryerson & Son, Inc.**, Chicago, has been completed. The new building provides approximately 118,000 sq ft of modern plant and office space. The plant portion is used principally to warehouse bar and sheet steel and tubular steel products.

For 16 consecutive years, year-end incentive payments have been distributed to employees of **Lincoln Electric Co.**, Cleveland. The annual distribution for last year totaled over $3 million. The average of the 1026 checks was $2929, with individual amounts ranging from $200 to $25,000..... In a move to consolidate activities and increase efficiency of operations, **Air Reduction Co., Inc.**, New York, has liquidated all of its wholly owned

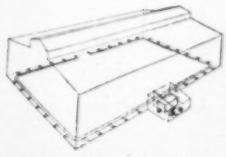
Direct Fired

WARM AIR HEATERS* by LEE

** a COMPLETE line for every application*



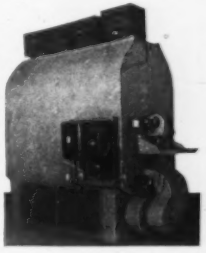
One or more heaters is placed inside of the space to be heated.



Heater is placed in a central location, warm air being delivered by ducts to space heated.

Whatever your needs in large scale heating you will find a Lee Direct Fired Unit to handle the job efficiently and economically. Over thirty years of experience in building quality heaters guarantees the proper unit for the job whether you contemplate a unit or central system. Illustrated at left are the two types mentioned — the top diagram shows an installation using one or more heaters in which capacities from 300,000 to 6 million Btu may be obtained. The bottom diagram illustrates the central system in which the heated air is distributed through ducts in which 3 million to 8 million Btu may be developed.

The efficiency of the Lee counter-current flow reduces fuel consumption; while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges, and also provides ventilation without additional cost. In addition to normal heating installations Lee Direct Fired Units may also be used for drying and curing in cases where these two operations are required.



It will pay you to investigate the Lee line today—literature is available describing completely the principal types of construction and versatility of operation as well as a partial list of prominent and satisfied Lee customers.

Please write us today.

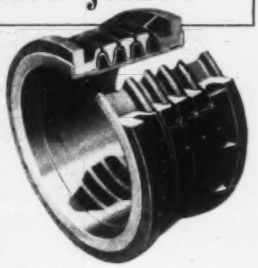
LEE ENGINEERING COMPANY

95 River Street **Hoboken, N. J.**

Which hat do you wear when selecting an expansion joint?

Maintenance Engineer? . . .

. . . then you want to avoid "trouble-makers". You'll save work with Badger Joints because they respond to thrust quickly — eliminate wear and tear on adjacent equipment. No maintenance on the joints themselves either, thanks to single tube packless construction.



Metallurgist? . . .

. . . you'll be impressed by Badger's modern heat-treating and forming methods which eliminate structure-weakening stresses . . . guarantee long-life, greater flexibility.

Plant Designer? . . .

. . . space requirements are important to you. Badger Packless Corrugated Expansion Joints require no more space than ordinary flanged fittings.

Treasurer? . . .

. . . of course you're thinking in terms of costs. So you'll be glad to know that Badger Joints bring you all these extra features at no extra cost!

Send today for new 24-page catalog just off the press!

Yes, everybody benefits when Badger Directed Flexing Packless Corrugated Expansion Joints are on the job. So isn't it wise to specify them always?

Badger

MANUFACTURING COMPANY

230-260 BENT STREET

CAMBRIDGE 41, MASS.

domestic subsidiaries. The respective businesses are now being conducted by corresponding divisions of the corporation. Foreign subsidiary companies are not involved and the new divisions are operating in the same manner and with the same organizations as the superseded companies.

A two-week training session on the application, installation, and servicing of the firm's gas, oil, and coal firing equipment was recently held at the plant of **Iron Fireman Mfg. Co.**, Cleveland. More than 80 representatives, division engineers, branch managers, and branch engineers attended. . . . . The Cleveland district office of **Penn Electric Switch Co.**, Goshen, Ind., has been moved to 728 Film Exchange Bldg. . . . . Several hundred dealers, factory representatives, and others in the warm air heating and air conditioning fields attended the opening of the new plant of **Harry F. Haldeman, Inc.**, Los Angeles.

To expand its warehouse facilities in the Philadelphia area, **Fafnir Bearing Co.**, New Britain, Conn., has acquired a building in that city. The structure now houses branch office and warehouse stock. . . . . **Bessemer Steel Corp.**, New York City, is managing the export business of **Union Malleable Mfg. Co.**, Ashland, Ohio. Bessemer Steel has a large staff of representatives in foreign markets.

Ajax Corp. of America, Chicago, in addition to manufacturing air conditioning units, is now handling national sales and distribution of a number of products, including dehumidifiers, manufactured by **Servel, Inc.**, Evansville, Ind. In line with its expansion plans, Ajax has named J. W. Bostwick, formerly with Servel, as executive vice president. J. C. Elliff, a former vice president of Stewart-Warner Corp., has joined the firm as vice president in charge of organization. Ervin A. Zern, with Fort Wayne Pump Co. for the past 30 years, is treasurer and comptroller. . . . . This year, **Davis Regulator Co.**, Chicago, is celebrating its 75th anniversary. The company was founded in 1875 by the father of George C. Davis, president.

Rotary booster ammonia compressors for use in low temperature applications have been developed by **York Corp.**, York, Pa. They are said to be especially suitable for increasing economically the capacities of existing low temperature systems where requirements have grown beyond the capacities of the plant. Booster compressors are installed on the low side in series with the high stage compressor. They are said to provide capacities from a few tons up to 250 tons in a single compressor. The operation is such that units always starts unloaded.

More uniformly coated electrolytic tin plate is said to be obtained by using a new instrument developed at the research laboratory of **Carnegie-Illinois Steel Corp.** This meter, which continuously indicates and records tin coating thickness on steel strip during the plating operation, is now in regular use on all "Ferrostan" electrolytic tinning lines of **United States Steel Corp.** Its function is to combine the electrical values of plating current, strip speed, strip width, and plating efficiency in a circuit employing a self balancing potentiometer.

WHO'S WHAT

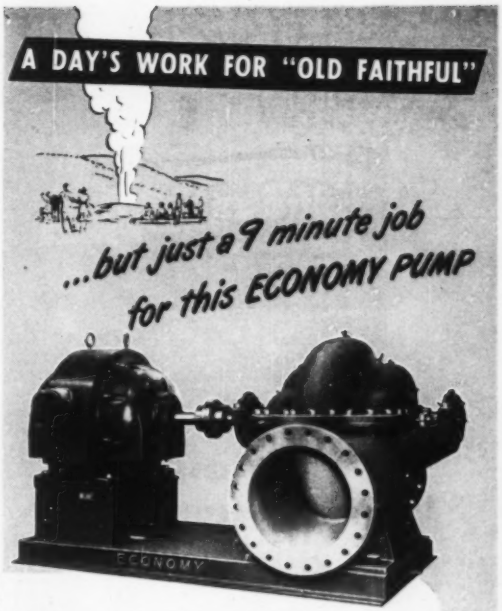
Allegheny Ludlum Steel Corp., Pittsburgh, has revamped its executive staff. **H. G. Batcheller,** president, is now chairman of the board and has been succeeded in the presidency by **E. B. Cleborne,** executive vice president. He, in turn, has been succeeded by **Edward J. Hanley,** vice president in charge of finances and treasurer. **Clark W. King,** vice president, is the new treasurer and **T. Ames Wheeler,** manager of the costs and statistics department, has been elected to the newly created office of controller.

The new vice president in charge of sales for **Baker Refrigeration Corp.,** South Windham, Me., is **Frederick W. Smith,** formerly products manager of merchandising equipment for Carrier Corp. **J. A. Kelly** is now managing production at both South Windham plants. He has been with the firm since June in charge of moving machine tools and other equipment to the newly acquired Little Falls plant. He was formerly manufacturing manager for Todd and Brown, Inc.

Cecil W. Farrar, director of sales promotion since 1948 for **Richmond Radiator Co.,** New York, has been made vice president and general manager of sales. **F. B. Mahoney,** who joined the company in 1944 as general factory manager, is now vice president and general manager of manufacturing. ..... At the recent first meeting of the **Radiant Heating Institute of California, Inc.,** Los Angeles, **A. L. Ottum,** president, **Horace Allison,** vice president, and **George Turner,** secretary-treasurer, presented the purposes and aims of the institute.

Jonas H. Ingram, Admiral U.S.N., retired, has become associated with **Reynolds Metals Co.,** Louisville, Ky., as executive representative. He was commander-in-chief of the Atlantic fleet at the close of World War II and, more recently, was commissioner of the All American professional football conference. **Paul C. Wilmore** is now regional manager of the firm's building products division, region I, which comprises the 11 western states. He was formerly with General Electric Co. in San Francisco. ..... **George L. Draffan,** president, Ohio Brass Co., has been elected to the board of directors of the **National Association of Manufacturers.** He will serve for this year and will represent the central Ohio district.

Arthur P. Shanklin, vice president, **Carrier Corp.,** has been placed in charge of its staff division and has been succeeded as head of the sales division by **O. W. Bynum** who has been elected a vice president. Mr. Shanklin joined the company in 1922 and became a vice president in 1942. Mr. Bynum was named general sales manager last year. **Pozner Electric Co.,** New York City, has been awarded a Carrier sales and service franchise. ..... **Leonard Kebler,** chairman of the board, Ward Leonard Electric Co., has been re-elected a board member of the **National Industrial Conference Board** for a term of one year. He was first elected a board member in 1946. **Arthur A. Berard,** president and general manager of Ward Leonard, has been elected to serve a three-year term as a board member of the **National Electrical Manufacturers Association.**



Erupting every 65.6 minutes, Old Faithful spouts a quarter-million gallons per day in an impressive display of Nature's "pumping" power. The same volume of water can be delivered in less than 9 minutes by an ECONOMY Double Suction Pump.

From 50 to 30,000 gallons per minute, there are more than 1500 Ratings of this Economy Double Suction Pump . . . to meet your requirements for any capacity at heads to 300 feet. Designed for general purpose pumping of clear liquids at moderate heads, these single stage units are suited to general water supply or heavy mill service.

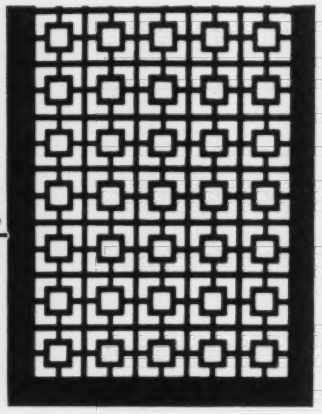
Sound hydraulic design give these Economy Pumps a broad, flat efficiency curve over a wide capacity range. Minimum maintenance is assured by sound engineering—based on such advantages as:

- Easy removal of complete rotor without exposing bearings.
- No leakage between sleeve and shaft . . . shaft sleeves are sealed.
- Flanged wearing rings, "L" shaped, inward flow.
- Unusually effective water seals.
- Large wells for lubrication.

If you wish full details, our Dept. C-2, will gladly send you Catalog A-1147.

Economy Pumps Inc.

DIVISION OF HAMILTON THOMAS CORP. HAMILTON, OHIO



One of Hendrick's *distinctive* grille designs

This attractive grille is the 2-inch Square Link, one of the hundred different designs in which Hendrick perforated metal grilles are available.

Made in heavy-gauge aluminum, brass, bronze, copper, Monel, steel and stainless steel, each design can be supplied in a wide range of overall dimensions, bar sizes, number of perforations and size of perforations. Ample open areas assure good air flow.

Sizes are accurate, perforations clean-cut, and there are no burrs or other imperfections. Installation is easy, because a special flattening operation in their manufacture gives the grilles uniformly flat surfaces.

Write for detailed information.

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Manufacturing Company
48 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

United States Radiator Corp., Detroit, has appointed **Edwin L. Malm** as manager of its hot water and steam accessories division. He has been in the heating industry for 25 years and has held key positions in the sales departments of several leading companies. . . . . The partnership of **Bueter & Wolff**, Chicago consulting engineers, has been dissolved and **Norman E. Bueter** is the sole owner of the business which now bears his name. **J. R. Simpson**, a member of the staff, heads the electrical division.

Dravo Corp., Pittsburgh, has made a number of management changes in its machinery division. **J. K. Beidler**, former purchasing agent, is now assistant general manager. **R. M. Rush** is manager of sales development and **H. M. Graham** is in charge of the apparatus department. **D. R. Berg** is managing the heating department and **B. B. Reilly** is manager of the air conditioning and combustion department. **G. P. Smith** has been named purchasing agent to succeed Mr. Beidler. A new distributor of its direct fired air heaters is **Condaire, Inc.**, 3248 Gravois, St. Louis, covering eastern Missouri and the southern half of Illinois. **Geo. B. Limbert & Co.**, 208 S. LaSalle St., Chicago, is representing the company in the sale and installation of fabricated piping in Illinois, Wisconsin, Minnesota, Iowa, northwest Indiana, western Michigan, and St. Louis County, Mo.

Roy M. Welch, assistant to the president, **Youngstown Sheet and Tube Co.**, Youngstown, Ohio, has retired after 48 years with the company. He is succeeded by **Myron S. Curtis**, manager of the sales promotion department. **James McConnell** has been promoted to superintendent of the company's merchant mills at the Indiana Harbor works. He has been assistant superintendent since 1938 and succeeds **Fred A. Schuessler** who died last summer. . . . . **Robert L. McFadin** has been named manager of merchandising sales for **Marley Co., Inc.**, Kansas City, Kans. He had been in charge of merchandising sales in the New York office.

Crane Co., Chicago, has acquired **United Plumbing and Mill Suppliers, Inc.**, Louisville, Ky., and is operating this business as a branch. Heading the new organization is **Charles E. Sims**, former assistant manager of the New York office. Assisting him is **Wilbur L. Craven** who has been resident Crane salesman in Louisville since 1946. In the New York branch office, **Charles F. Laird**, former Pittsburgh manager, is in charge. He has taken over the post of **Paul R. Berryman**, now manager of trade relations. **Darrell R. Nordwall**, former manager of export sales, is assistant manager and **Joseph W. Green** is sales manager. In the Pittsburgh office, **Horace R. Riggs** is the new manager. He had been the Lima, Ohio, branch manager. Assisting him is **Fred Crowley**, former manager of industrial sales at Pittsburgh. In the Lima office, **Ralph C. Schroeder**, formerly assistant Pittsburgh manager, is in charge. At the Columbus, Ohio, branch, **John H. Wasson**, former assistant manager, is now manager and has succeeded **James M. Grimm**, retired. The assistant manager is **Gene E. Langley**, formerly of the general office sales promotion department.

R. E. Barnett has been promoted to assistant sales manager of **Marsh Instrument Co.**, sales affiliate of **Jas. P. Marsh Corp.**, Skokie, Ill. He has been with the organiza-

tion for the past nine years. ..... **Robert A. Anderson** is now vice president and works manager of the Kalamazoo, Mich., plant of **Ingersoll Steel Div., Borg-Warner Corp.**, Chicago. He had been associated with the division in various capacities for 18 years before leaving in 1948 to operate as a sales representative for Ingram-Richardson Mfg. Co.

Minneapolis-Honeywell Regulator Co., Minneapolis, has announced a number of personnel changes. **Herbert D. Bissell,** former general advertising manager of Electric Auto-Lite Co., is executive vice president in charge of advertising, sales promotion, and merchandising departments. **Fred Kaiser,** midwest regional manager since 1942, has been promoted to the newly created position of field sales manager and is succeeded by **Clarence L. Peterson** who has been Pacific regional manager. **Gavin S. Younkin,** Los Angeles branch manager since 1943, has taken over Mr. Peterson's post and **Reginald C. Cushing** has been promoted to branch manager of the San Francisco office.

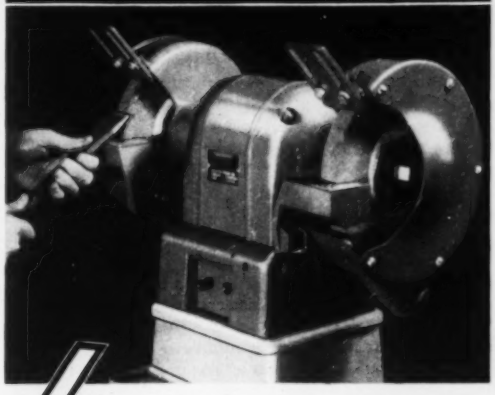
Raymond K. Serfass is the new assistant general sales manager of **York Corp.**, York, Pa. He had been industrial sales manager of the north Atlantic district, with headquarters in New York. **Alvin N. Barnes, Jr.,** with the firm for nearly 30 years, has taken over the former post of Mr. Serfass. Formerly branch manager in Seattle, **William R. H. Eby** has been named to the newly created position of industrial sales manager of the Pacific district, with headquarters in Los Angeles. **G. Mason Gerhart,** assistant to the commercial sales manager of the Houston, Tex., branch, has been transferred to the home office as a sales engineer.

With headquarters in the Chicago office, **Howard H. Pruneau** is now construction equipment regional supervisor for the midwest territory of **Worthington Pump and Machinery Corp.**, Harrison, N. J. Formerly a sales engineer located at Missoula, Mont., he succeeds **H. J. Schultz** who resigned. ..... **David Innes,** former manager of **Owens-Illinois Glass Co.'s** Kaylo division plant in Sayreville, N. J., is now product development engineer. He is working in connection with the sales department in Toledo and has been replaced in Sayreville by **O. W. Pfeiffer.**

Previously a field engineer in the St. Louis branch, **E. P. Jastram, Jr.,** is the new chief engineer of **Spencer Thermostat Div., Metals and Controls Corp.**, Attleboro, Mass. His former duties have been taken over by **C. A. Peterson** of the headquarters sales force. Field engineer for the newly formed territory with headquarters in Dayton, Ohio, is **B. O. Haun, Jr.** In addition to managing the automotive and aircraft section of Spencer, **Jerry Ottmar** has also assumed the duties of sales promotion manager for the division.

Joy Mfg. Co., Pittsburgh, has appointed **R. G. Gehlsen** sales manager of its mines equipment division. Since 1947 he has been manager of mining sales. The new manager of the division's industrial sales is **H. B. Zeppenfeld.** ..... **Herbert G. Kieswetter,** formerly vice president and assistant general manager, United

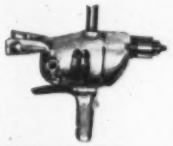
4 B&D BENCH GRINDERS—6" to 10" wheel diams.
Standard and Heavy-Duty models—from $38.00



4 ways to CUT GRINDING COSTS!

BLACK & DECKER BENCH GRINDERS give you the *right* tool at the *right* price, whether you need a Bench Grinder for occasional or continuous use! They'll speed up your tool sharpening; grind pipe, rings, connections, fixtures; wire brush, buff, burnish, polish and finish sheet metal; remove saw or shear burrs and weld marks. Their modern design gives you more working clearance. Their dependable B&D-built "constant speed" motors maintain correct operating speed. Their high-quality parts are *built to last*, give you more work for your money! See your nearby B&D Distributor for a demonstration. Write for free catalog to: THE BLACK & DECKER MFG. CO., 628 Pennsylvania Ave., Towson 4, Maryland.

Buy These Other Black & Decker Tools for Faster Work on Many Jobs!



25 B&D ELECTRIC DRILLS *from* ¼" *to* 1¼" *capacity.*

4 B&D ELECTRIC HAMMERS *rated by drilling capacity in concrete from* ½" *to* 2".

3 B&D ELECTRIC PORTO-SHEARS* *in 18, 16 and 12-gage capacities.*

25 B&D SCREW DRIVERS *for wide range of screw driving and nut running.*

4 B&D ELECTRIC SANDERS *7" and 9" disc diams.*

LEADING DISTRIBUTORS EVERYWHERE SELL

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PORTABLE ELECTRIC TOOLS

*Trade Mark Reg. U. S. Pat. Off.

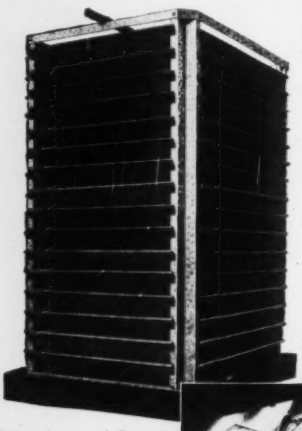
States Rubber Export Co., Ltd., has been named assistant general manager of the mechanical goods division, **United State Rubber Co.,** New York. ..... **Robert T. Pring** is technical director of the dust and fume division of **American Wheelabrator & Equipment Corp.,** Mishawaka, Ind. He had been director of the industrial hygiene department, Kennecott Copper Corp.

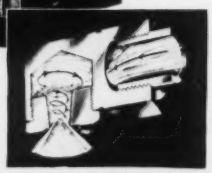
Combustion Engineering-Superheater, Inc., New York, has established a western division with headquarters in Los Angeles and branch offices in San Francisco and Seattle. **Robert M. Hatfield, Jr.,** formerly assistant general sales manager, is in charge of the division which covers the states of Washington, Oregon, California, Nevada, and Arizona. **H. G. Thielscher,** formerly resident engineer of the west coast, is now chief engineer of the division, with headquarters in San Francisco. **Frank Bader,** of the Philadelphia office, has been transferred to San Francisco, and **Elmo Keeler,** of the New York office, has been moved to Los Angeles. **Hugh Nickle,** district manager of the northwest, continues in that capacity with offices in Seattle. Other promotions and transfers: **Arthur Hunter,** assistant Philadephia manager, to New York as an assistant general sales manager; **Robert L. Riker,** manager of the proposition department, also an assistant general sales manager; **G. P. Ellis,** formerly western manager, now Washington, D. C., manager; **T. J. McGowan** from the Washington, D. C., office to the Philadelphia office.

Link-Belt Co., Chicago, has announced a number of personnel changes in plant management. **Richard E. Whinrey,** assistant general manager at the Dodge plant, Indianapolis, will, on May 1, become assistant general manager at the Ewart plant, Indianapolis. **Raymond S. Wood,** general manager at the Minneapolis plant, is now assistant general manager at the Dodge plant, replacing Mr. Whinrey. **Leslie J. Carson,** chief engineer at the Caldwell plant in Chicago, has become general manager of the Minneapolis plant and the north central sales division. **William P. Ridsdale,** who has been chief engineer at Dallas and Houston since 1946, is now chief engineer at the Caldwell plant.

James A. Norris, who has been serving as west coast district manager of **Kerotest Mfg. Co.,** Pittsburgh, is now general sales manager of the brass division. ..... **John M. Tuthill** has been advanced from assistant manager to manager of flat rolled sales of **Youngstown Sheet and Tube Co.,** Youngstown, Ohio, succeeding **Walter E. Scott** who has retired after 43 years with the company. **L. E. Arnold,** a salesman in the Detroit district office, has taken over Mr. Tuthill's former position. ..... **Ralph Hanes** is directing advertising and sales promotion of **Dodge Mfg. Corp.,** Mishawaka, Ind. Since 1942 he had been sales promotion manager of the mechanical goods division, United States Rubber Co. He now occupies the position which had been held for more than 20 years by the late **W. W. French.**

Kritzer Radiant Coils, Chicago, has appointed four new district representatives. **F. E. Prawl,** of Prawl Engineering Corp., Omaha, is covering Nebraska and the far western portion of Iowa. **M. M. Berger,** M. M. Berger and





Binks clog-proof Rotojet spray nozzles contribute much to the high efficiency of Binks towers. Their side-inlet, whirl-chamber design and precision manufacture assure maximum fluid break-up and long life.

SLASH your cooling water cost

install a **Binks** *natural draft cooling tower*

You can cut your cooling water bill to almost nothing by installing a Binks Type "S" Natural Draft Cooling Tower. This type of tower is excellent where air movement is unrestricted*. You recirculate the same water over and over, passing it through the cooling tower each time. A small pumping cost replaces high water bills.

Binks Type "S" Cooling Towers are made in a variety of types and sizes, handling from 15 to 1200 gallons per minute with high efficiency. These towers will provide you with many years of trouble-free service.

ideal for many applications

Binks Type "S" Cooling Towers are the accepted standard for cooling condenser circulating water from refrigeration and air conditioning compressors...for cooling water-jacketed engines...or for low-cost cooling in many manufacturing processes where heat is dissipated by spraying water or other fluids.

**Ask about Binks Mechanical Draft Towers for locations where air movement is limited.*

Send today for FREE Bulletins

which give full information about Binks Type "S" Towers:

Bulletin 30—Single section towers
Bulletin 31—Multiple section towers
Bulletin 32—Large capacity towers
Bulletin 40—All Redwood towers

Please state how tower will be used, also capacity required.

THERE'S A BINKS TOWER FOR EVERY COOLING JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 CARROLL AVENUE, CHICAGO, ILL.

Associates, Cleveland, is covering the northern part of Ohio and northwestern Pennsylvania. **A. A. Aiken,** of A. A. Aiken Engineering Sales Co., Lansing, Mich., is covering that state, and **William Schuler,** with headquarters in Rock Island, Ill., is handling representation in western Illinois and eastern Iowa. ..... **W. G. Tolman,** who had previously been retained in a consulting capacity, has joined **C. A. Dunham Co.,** Chicago, and is production manager at the Michigan City, Ind., plant.

Several promotions and additions to the management staff of **Meyer Furnace Co.,** Peoria, Ill., have been made recently. **Russell S. Quimby,** former sales manager, is now general sales manager and is directing all sales activities of the manufacturing divisions. **Hugh C. Garver, Jr.,** assistant to the president, is in charge of private brand, government, and project sales. **Harold V. Walker,** who has returned to the company after an absence of two years, is assistant sales manager. **Charles A. Raper** is now advertising and sales promotion manager. **Ray W. Qualley,** who has been chief product engineer, has been promoted to factory manager in charge of the Peoria and Peru plants. **John J. Boland,** chief application engineer, is supervising product design work.

After 16 years with Mueller Brass Co., **Buel A. Devine** is jobbers field representative for **Wolverine Tube Div., Calumet & Hecla Consolidated Copper Co.,** Detroit. He is working directly with the sales force and among wholesalers, architects, contractors, and public works people. ..... **Morse Chain Co., Div. of Borg-Warner Corp.,** Chicago, has named **Robert G. Holmes** branch manager of the Chicago sales office. For the last 12 years he has been a sales engineer in the Chicago and St. Louis areas. ..... **G. F. Nightingale** has organized a new company, located at 4806 W. Chicago Ave., Chicago, to represent manufacturers of heating and ventilating equipment.

According to **Unistrut Products Co.,** Chicago, **Creston E. Kite** is now general manager of **Unistrut Eastern Service Co.** which has opened office and warehouse facilities at 74 Woolsey St., Irvington, N. J. Mr. Kite is a former general sales manager of Abarry Steel Co., vice president in charge of sales of General Alloys Corp., and sales executive of E. F. Houghton & Co. ..... For the past 25 years, **A. V. Adamson** has managed the New York district office of **Combustion Engineering-Superheater Co., Inc.,** New York. Last month he retired, but is serving the firm in a consulting capacity.

The Buffalo division of **Fedders-Quigan Corp.,** Buffalo, N. Y., is now managed by **Anthony J. DeFino** who has held key positions in various phases of company sales and manufacturing activities centering around heat transfer equipment. ..... **York-Shipley, Inc.,** York, Pa., has established a greatly expanded merchandising division managed by **Dave Wepman** who has been active in the oil heating field for over 20 years. **W. W. Kane,** recently in charge of cooperative advertising, is coordinator of the new division. ..... **Herbert J. Cooper,** who has been engaged in practical research in the development of centrifugal casting and oxygen injection techniques at **Cooper Alloy Foundry Co.,** Hillside, N. J., has been named assistant to the general manager.

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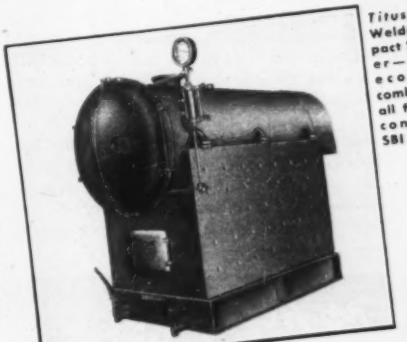
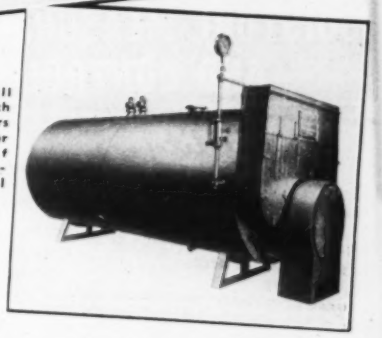
A COMPLETE LINE OF DEPENDABLE, ALL WELDED

HEATING BOILERS

IN SIZES AND RATINGS TO FIT EVERY REQUIREMENT



Titusville All Welded, Compact Steel Boiler—provides economical combustion for all fuels. ASME constructed, SBI rated.



Titusville All Welded Scotch Heating Boilers—available for all types of fuel. ASME constructed, SBI rated.

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Write today for new technical, informative bulletins

The TITUSVILLE IRON WORKS Co.

DIVISION OF STRUTHERS WELLS CORPORATION

TITUSVILLE, PENNSYLVANIA

Succeeding **H. E. Wheeler,** of Chicago, **R. W. Noll,** Los Angeles, has been elected president of the **Refrigeration and Air Conditioning Contractors Association.** Other officers serving with him are: first vice president—**Theodore A. Reina,** Brooklyn; second vice president—**A. M. Palen,** St. Paul, Minn.; treasurer—**L. J. Quinn,** Cincinnati; recording secretary—**Ralph W. Lampie,** Richmond, Va.; sergeant-at-arms—**A. G. Weber,** Detroit. ..... The new northeastern sales representative for **Viking Air Conditioning Corp.,** Cleveland, is **Lyall M. Bush,** of West Springfield, Mass. He is covering the New England states, metropolitan New York, and northern New Jersey.

Walter M. Barber, who has been in sales promotion work for 35 years, has recently become sales promotion and advertising manager of **Perfection Stove Co.,** Cleveland. Since early 1942 he has managed the Cleveland district sales office. ..... **Bryant Heater Div., Affiliated Gas Equipment, Inc.,** Cleveland, has appointed **Bryant-Leaumont Co.,** 3041 Paris Ave., New Orleans, sole distributor in that territory. **Walter Leaumont,** who until recently was vice president and sales manager of Souther Heater Co., is president of the new firm and will be assisted by **Lucien Vivien,** vice president. The company is a wholesale distributor for Bryant products only.

The **Ventilating and Air Conditioning Contractors Association of Chicago** has re-elected **Otto A. Wendt** president for a third term. Other officers re-elected include: vice president—**Robert G. Wiersig;** secretary—**P. W. Olmen;** treasurer—**Porter R. West;** directors for two-year terms—**J. J. Haines** and **E. B. Brown, Jr. William Mathis** was elected a director for one year and **L. W. Rogers** continues as executive secretary. ..... **Illinois Engineering Co.,** Chicago, has appointed **Thomas Engineering Co.,** 1325 E. 35th St., Tulsa, representative for the state of Oklahoma.

Roger D. Anderson, 3409 Martin Ave., Omaha, is the new sales representative in Nebraska and western Iowa for **National Radiator Co.,** Johnstown, Pa. During the past year he operated his own business as a partner of Anderson Bros. Engineering Co. **Paul O. Bergeron,** with headquarters at 620 Newbury St., is sales engineer and architects' representative for the Boston sales office. He comes to National Radiator from the sales staff of York-Shipley, Inc. ..... Connected with the air conditioning field since 1932, **Alfred C. Baechlin,** of A. C. Baechlin Co., Phoenix, is the new direct representative of **Patterson-Kelley Co., Inc.,** East Stroudsburg, Pa., in the state of Arizona. **J. R. Dowdell & Co.,** with offices at 4024 Swiss Ave., Dallas, and 416 M & M Bldg., Houston, has been named special representative in the Dallas and Houston areas.

Mitchell Mfg. Co., Chicago, has appointed the following franchised distributors for room air conditioners: **Raymond Rosen Co.,** Philadelphia; **Arnold Wholesale Co.,** Cleveland; **Northeastern Distributors,** Boston; **V. J. McGranahan Co.,** Toledo; **Southern Wholesalers,** Shreveport, La.; **Marlin Associates,** Dallas; **Simon Distributing Co.,** Washington, D. C.; **I. Feldman Co.,** Providence, R. I.; and **Appliance Distributing Co.,** Columbus, Ohio. .....

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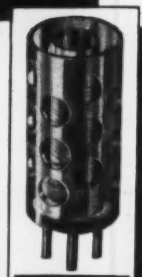
MOISTURE MEASUREMENT AND CONTROL

AMINCO DUNMORE
ELECTRIC HYGROMETER

Versatility . . .
(INSTALLATIONS NOW IN USE)

DRUGS . . . insuring bone-dry bottling of widely used hygroscopic drug product.
FOOD . . . preventing spoilage of grain in storage.
GRAIN (ANIMAL FEED) . . . preventing spoilage after packaging.
CORROSION-PROTECTION PACKAGING . . . protection of various equipment ranging from tiny delicate electronic components to heavy ordnance.
GLASS . . . checking and controlling moisture permeability of glass wool and ageing characteristics of bottles.
CEMENT . . . checking drying and setting characteristics.
PAPER . . . controlling humidity to insure proper printing qualities.
PHOTOGRAPHIC FILMS . . . insuring uniform quality by controlling humidity in emulsion-coating rooms.
FOUNDRIES . . . controlling dryness of sand molds to prevent blowholes and accidents.
BOTTLED GASES . . . checking and controlling moisture content of oxygen and other gases.
NATURAL GAS . . . eliminating costly interruption of service due to excessive moisture in pipelines.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SENSITIVITY . . . detects humidity changes as small as plus-minus 0.15% relative humidity.
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WIDE ADAPTABILITY . . . measures, indicates, records and/or controls relative humidity. Drives air-operated devices. Can be used for remote control. Neither adds nor removes moisture or heat (can be built into sealed electrical components). Measures moisture content of solids, air, and other non-corrosive gases.

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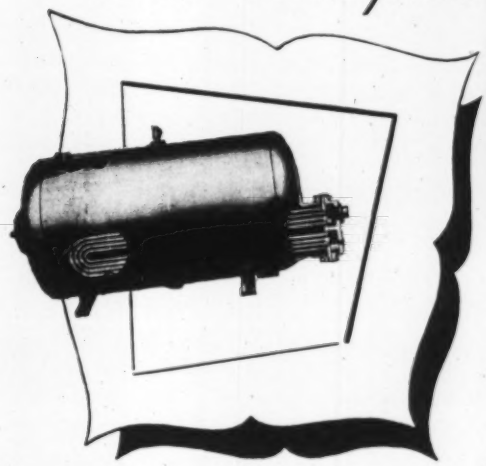

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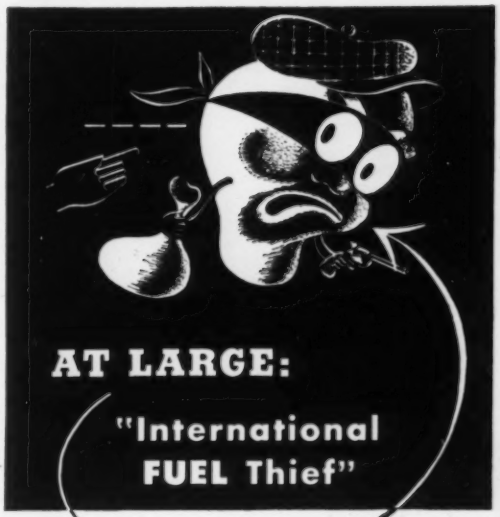

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THE HOUSE OF **Carey**

J. S. Beecher is now a member of the technical department of the power chemicals division of **E. F. Drew & Co., Inc.,** New York. He has been a sales and service engineer in the firm's Pittsburgh area.

Bernard Lester, John A. Silver, and **Frank W. Hankins** have formed the management engineering firm of **Lester, Hankins, and Silver,** 1605 Race St., Philadelphia, and 140 Cedar St., New York. The firm will specialize in the management, distribution, and sales problems of manufacturers and distributors of machinery, equipment, and technical products. For many years, Mr. Lester was in charge of sales in the equipment field for Westinghouse Electric Corp. and recently has been consultant to a number of equipment manufacturers. Mr. Silver was formerly director and executive vice president of F. J. Stokes Machine Co. Mr. Hankins has been in marketing research and sales counselling for over 25 years. He has been chief engineer of Columbian Rope Corp. and manager of the marketing department of Worthington Pump and Machinery Corp.

B. J. Lattner, vice president, has succeeded **M. D. McWilliams** as director of heating equipment sales for **Century Engineering Corp.,** Cedar Rapids, Iowa. Mr. Lattner is the son of E. J. Lattner, company president, and the grandson of J. A. Lattner, chairman of the board. Mr. McWilliams has retired after more than 20 years with the firm. ..... **G. Kenneth Fisher** has been admitted as a general partner to the firm of **Sheffler-Gross Co., Inc.,** Philadelphia sales engineers handling heating and power plant equipment and temperature control apparatus. He joined the firm as a sales engineer in 1940.

George W. Wood, York, Pa., has recently joined the engineering staff of **Harvey-Whipple, Inc.,** Springfield, Mass. He had been supervisor of the engineering laboratory of York-Shipley, Inc., and before that, was an instructor in mechanical engineering at Pennsylvania State College. ..... **William A. Casler** is assistant director of research at **Armour Research Foundation of Illinois Institute of Technology.** He is in charge of stimulating new fields of research and will assist in the administrative operation of the research division. His appointment adds a second assistant director to the staff.

H. K. Lange has retired from active service and has resigned from his position as publicity director of the **Vermiculite Institute,** Chicago. **L. A. Castell,** his assistant since 1943, has succeeded him as editorial director. .... **Automatic Control Co.,** St. Paul, Minn., has named **Dean M. Thomas,** 1807 Elmwood Ave., Buffalo, as the new western New York representative. In the New Mexico area, representation is being handled by **Lou Hoffman,** P. O. Box 1515, Albuquerque.

Hajoca Corp., Philadelphia, has purchased **Rowland Supply Co.,** High Point, N. C. **O. L. Rowland,** former owner, will remain in an advisory capacity for two years and **C. B. Hurley,** formerly of the Rowland firm, is managing the new branch. **Leon Aronson** has been appointed to the Philadelphia branch refrigeration sales department.

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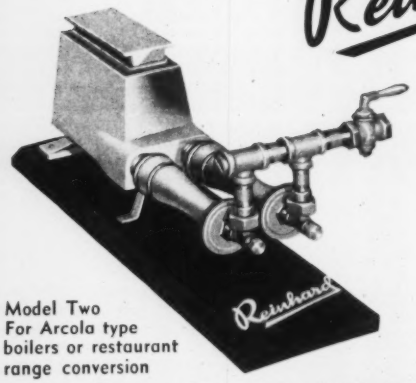

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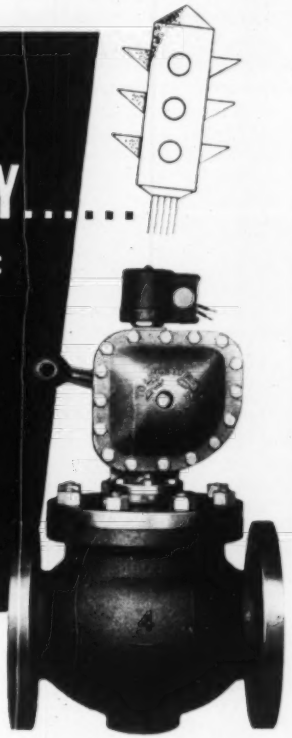
AUTOMATIC SHUT-OFF VALVE FOR THAT GAS BURNER!



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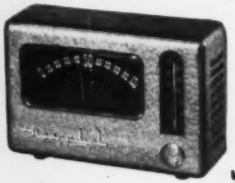

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NEW BOOKS & REPORTS

Proposes Tentative Design Procedure for Gaskets and Bolted Joints

Gaskets and Bolted Joints, by Irving Roberts, division engineer, process division, research and development department, Elliott Co., consists of a study of the loading requirements of gaskets in bolted joints, with the object of developing a rational basis for the design of such joints. Starting with an analysis of gasket conditions for tightness, the gasket factor m is defined as the average gasket stress at which a leak occurs divided by the corresponding internal pressure, and its variation with initial gasket stress and gasket width is predicted. These trends are confirmed by a survey of the available literature data.

In a bolted joint, gasket stress becomes a function of the elastic constants of the system. Equations are derived to predict gasket and bolt stresses resulting from application of internal and fluid pressure, and typical elastic recovery curves for an asbestos gasket are presented. Consideration is given to the effect of gasket creep in a bolted joint, and to the problem of distribution of bolt load, for which an approximate theory is derived.

Defects in the ASME Code are pointed out, and a tentative new design procedure is proposed. Finally, a summary of data which should be obtained for use with the new design procedure is given.

Identified as Paper No. 49—A-2, the report was presented at the recent annual meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

Revises Fundamental Text on Heating, Air Conditioning

Heating, Ventilating and Air Conditioning Fundamentals (second edition) by William H. Severns and Julian R. Fellows, includes sufficient material for undergraduate courses in the subject, as usually given for students in architecture, architectural engineering, and mechanical engineering. The purpose of this new edition remains the same as that of the first, published in 1937—to present essential fundamentals.

The authors, both professors of mechanical engineering at the University of Illinois, have revised the earlier work so as to include up-to-date data, together with examples of typical calculations and accepted commercial practices. Nearly 200 pages have been added on new material covering warm air heating, hot water heating, panel heating, refrigeration, air purification, the determination of cooling loads, and air conditioning.

The clothbound text contains 666 + vii pages, 6 in. × 9 in., is published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, and the price is $6.50.

Analyzes Cyclone Dust Collector Efficiencies

In his paper, Cyclone Dust Collector Design, Melvin W. First, of the Harvard School of Public Health, states that quantitative investigations of velocity, static pressure, and flow direction in cyclones of various designs and sizes demonstrate that energy loss is directly related to internal cyclone velocity, and that energy loss results from internal shear of adjacent gas strata rotating at different speeds

and at different flow angles. Cyclone dimensions found to be significant in cyclone energy loss are said to be entry height and width, exit duct diameter, the ratios of cylinder and core height to cyclone diameter, and the presence or absence and type of entry vane. Entry vanes completely closing off the annular space in the cyclone were found to induce a double-eddy type flow in the upper half. All other designs were found to show a well defined double spiral flow.

Dust studies, says the author, indicate that cyclones having narrow entries without vanes possess important advantages for high efficiency performance. He also states that dust gradients show that gas flow rate is not a major variable in determining cyclone efficiency.

Presented at the recent annual meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York City, the paper is identified as No. 49—A-127.

Finds Corrosion Fatigue Cracks in Steam Piping Often Caused by Water Contact

In recent years there has been a number of serious cases of cracking in the steam piping systems of British power stations. As a result, the Central Electricity Board formed a committee of representative plant manufacturers and operators, engineering insurance companies, and the Department of Scientific and Industrial Research to investigate the cause of corrosion fatigue cracking in steam piping systems.

In a progress report of the committee, the formation of cracks by fatigue, when the endurance has been lowered by the action of a liquid which wets the surface, is referred to as corrosion fatigue. It was soon recognized that the trouble was due to water, usually condensate, coming in contact with hot metal. The report leads off with a section devoted to the mechanism of crack development; covering fatigue failure, corrosion fatigue, corrosion fatigue by mechanical stressing and, corrosion fatigue by thermal stressing. Steam receiver bodies and connections, steam piping, spray type desuperheaters, and feed connections to boiler drums are discussed as locations where failure may be expected. After describing methods of detection and observation, the report gives recommendations regarding the layout of a new plant, alterations to existing plants, the operation of steam piping systems, and plant supervision.

Corrosion Fatigue Cracking in Steam Pipe Systems at Power Stations is a 20 page, paper covered report issued by the British Electrical Authority, British Electricity House, Great Portland St., London, W. 1, England.

Other Books and Reports Received

Radiant Heating (second edition), by T. Napier Adlam —Published by Industrial Press, 148 Lafayette St., New York 13, contains 504 clothbound pages and is priced at $6.00. The author's long practical experience with panel heating, both abroad and in this country, has enabled him to present in a comprehensive way information on heat input and output; the relation of mean radiant temperature and air temperature; construction details; controls; air venting; the effects of floor coverings; the use of ceiling and floor panels; wall, baseboard, electrical, and metal panels; the determination of panel size and tube spacing; radiant cooling; and snow melting by em-

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Canning	Laundry	Shipbuilding
Ceramic	Leather	Shoe
Chemical	Match	Smelting
Dairy	Meat Packing	Soap
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bedded pipes. The final chapter contains 78 charts for the direct determination of pipe size and spacing and covers both iron or steel pipe and copper tubing.

Some New Values of the Second Enthalpy Coefficient for Dry Air, by J. R. Anderson, assistant professor of mechanical engineering, Towne Scientific School, University of Pennsylvania—Technical paper No. 49—A-40 of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18. Measurements of the second enthalpy coefficient for dry, CO_2-free air are reported for three temperatures: 0 C, 10 C, and 30 C. These values, which are said to be in excellent agreement with the best data on air in the literature, were formulated, together with the data of Eucken, Clusius, and Berger by the equation

$$\beta = -0.05442G\,(0.01226T),\ \text{ft}^3/\text{lb}$$

The second virial coefficient was then calculated by means of the equation

$$B = 0.05442\,F\,(0.01226\,T) - 2.33 \times 10^{-5}T,\ \text{ft}^3/\text{lb}$$

where the value of the constant of integration was adjusted to give the best fit with the Holborn and Schultze compressibility data.

Practical Considerations in Industrial Oil Firing, by H. E. Schwiebert, gasoline and fuel oil department, Socony-Vacuum Oil Co., Inc.—Technical paper No. 49—F-7, presented at last year's fall meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18. Because the paper covers broad aspects of the use of fuel oil in industrial combustion, only fundamental considerations are covered. A few general comments and pertinent remarks are given on such factors as fuel selection, types of oil burners, burner and air adjustment, combustion space, fuel oil factors, and residual fuel oil supply.

Method and Procedure for the Determination of Dissolved Oxygen—Published by the Heat Exchange Institute, 90 West St., New York 6, and available for $2.00. The method and procedure described in the standard is said to produce reliable results, even when employed for the analysis of waters containing reasonable quantities of impurities. The apparatus recommended, the method of sample collection, the procedures for fixing and titrating samples, as well as the computation of results, are described and illustrated. The accuracy and limitations of the test method and procedure are explained.

Preparation and Revision of Building Codes, by George N. Thompson—Building Materials and Structures Report BMS116, published by the U. S. Department of Commerce, National Bureau of Standards. Copies may be obtained for 15 cents from the Superintendent of Documents, U. S. Government Printing Office. The pamphlet tells how code preparation and revision work is done, and useful sources of technical information are indicated. Problems encountered by local committees are discussed, including basic principles involved, methods of presentation, arrangement, numbering, advantages of using national standards, methods of recognizing new materials and new methods of construction, and other questions of major importance.

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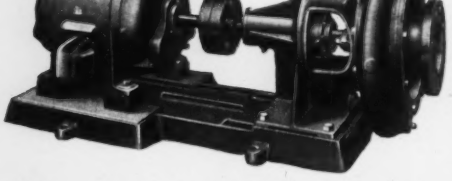

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 151. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

HPAC 7534—AIR COMPRESSORS—Joy Mfg. Co., Henry W. Oliver Bldg., Pittsburgh 22, has released a new bulletin (No. A-56) on its WL-80 "Unitair" compressors. The bulletin includes a selector chart, detailed section drawings, and parts photographs. These compressors are available in 11 sizes, 15 to 125 hp, and are of the two stage, air cooled type.

HPAC 7535—AIR CONDITIONERS—Bulletin 6 of Buensod-Stacey, Inc., 60 E. 42nd St., New York 17, covers central station air conditioners. Various portions of the booklet deal separately with the fan, heater and bypass, spray type dehumidifier, filter, and outside and return sections of conditioners. General specifications are given for units which range in size from 22 to 59 tons. Accessories for spray type humidifiers and dehumidifiers are also illustrated.

HPAC 7536—ALUMINUM ALLOY PROPERTIES—A new folder, the first to cover the range of aluminum products made by Magnesium-Aluminum Div., Revere Copper and Brass, Inc., 230 Park Ave., New York 17, is now available. A condensed chart gives the physical properties of most of the aluminum alloys available in the form of wrought products. Also included are descriptions of product forms, such as extruded shapes, tubes, and coiled sheet.

HPAC 7537—BASEBOARD, FINNED TUBE, FINNED PIPE COILS—The first issue of the house organ published by Kritzer Radiant Coils, 2901 W. Lawrence Ave., Chicago 25, is off the press. Company representatives are pictured and corresponding territories are given. A brief history of the firm is included and baseboard coils, "Fin Tube" radiant coils, and "Fin Pipe" commercial coils are briefly described and illustrated.

HPAC 7538—BASEBOARD RADIATION—A new bulletin (No. 639D) on baseboard radiation is the first in a new series describing all types of heating equipment manufactured by C. A. Dunham Co., 400 W. Madison St., Chicago 6. The 16 page booklet contains ratings and engineering data for determining radiation sizes and piping design.

HPAC 7539—BOILER-STOKER COMBINATIONS—Bulletin SF-1 of Brownell Co., 408 N. Findlay St., Dayton 1, Ohio, covers "Unitbilt" boiler-stoker combinations. Design and construction features of the electric welded steel boiler and the type F worm feed stoker are covered and dimensions, capacities, and other pertinent data are included. SBI ratings range from 2190 to 8500 sq ft of steam radiation.

MEETINGS & CONVENTIONS

American Society for Testing Materials, 1916 Race St., Philadelphia 3—Committee week and spring meeting, Hotel William Penn, Pittsburgh, February 27 to March 3.

The 53rd annual meeting and 9th Exhibit of Testing Apparatus and Related Equipment will be held June 26 to 30, Chalfonte-Haddon Hall, Atlantic City.

National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2—The 6th annual conference, St. Louis, April 4 to 7. Symposia under consideration include round table discussions on general corrosion problems and corrosion in connection with pipe lines, refrigeration and air conditioning, and the food industry.

The 12th Annual Midwest Power Conference—To be held April 5 to 7, Sherman Hotel, Chicago. The affair is sponsored by Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, with the cooperation of 18 midwestern universities and professional societies. Dr. E. R. Whitehead, director of electrical engineering at Illinois Tech, is conference secretary.

New Jersey Society of Professional Engineers, 86 E. State St., Trenton 8, N. J.—The 26th annual convention and an industrial, engineering, and commercial exhibit, April 14 and 15, Essex House, 1050 Broad St., Newark, N. J.

National Oil Heat Exposition, sponsored by the Oil-Heat Institute of America, Inc., 6 E. 39th St., New York 16.—The affair will be held in conjunction with the 27th annual meeting of OHI, April 24 to 28, Commercial Museum, Philadelphia.

Sheet Metal Contractors Association of Illinois—Annual meeting and exhibit, State Armory Bldg., Springfield, Ill., April 27 to 29. George L. Folkers, 709 S. Adams St., Peoria 2, Ill., is convention exhibit chairman.

Heating, Piping, and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20—1950 annual meeting, May 8 to 12, St. Francis hotel, San Francisco.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6—The 41st annual meeting, Grove Park Inn, Asheville, N. C., May 23 to 26.

The Hotel Statler, Detroit, has been selected for the Society's 1951 annual meeting.

Canadian International Trade Fair—To be held May 29 to June 9, Exhibition Grounds, Toronto, Canada.

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1—The 1950 annual meeting, to be held in Chicago, early in June.

American Society of Refrigerating Engineers, 40 W. 40th St., New York 18—The 37th spring meeting, June 4 to 7, Muehlebach hotel, Kansas City, Mo. Nine papers, grouped into one session of technical papers and two sessions of application type papers are scheduled.

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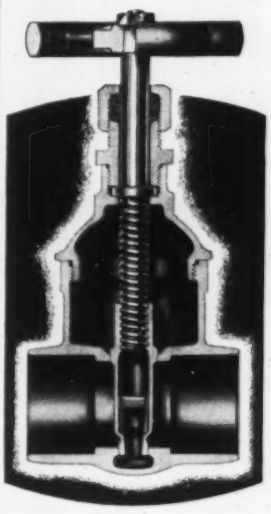
Solder Joint

VALVE



Sizes available—⅜" to 2"

Whether it's a water supply system, a radiant heating job, or an industrial coolant piping system, if you are using copper tube you will save installation time and assure yourself of a dependable flow control installation when you install KENNEDY Solder Joint Valves.

Made throughout to the same unsurpassed quality standards as KENNEDY Screwed and Flanged Gate Valves they offer you the service assurance gained in 73 years of valve-making experience plus the modern ease and speed of installation to be had from a solder joint connection.

Sockets are smooth with precise clearance to assure free, even flow of solder all around for a solid, leak-proof joint.

The new cylindrical design of the upper part of the body provides maximum strength with light weight. It equalizes pressure, resists strain and gives the extra rigidity that prevents distortion of the body.

KENNEDY Fig. 1-SJ Solder Joint Valves are recommended for low pressure steam (not exceeding 15 pounds gauge) and 150 pound water services at temperatures up to 250 degrees F., when joints are made up with ordinary solder. They are also recommended for steam services up to 100 pounds and temperatures up to 450 degrees F., when suitable solder or low temperature brazing alloy is used.

WRITE FOR BULLETIN 103 • BUY FROM YOUR LOCAL DISTRIBUTOR

THE KENNEDY VALVE MFG. CO.
1053 EAST WATER ST.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS
OFFICE-WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

LOW COST TROUBLE FREE FEED PUMP

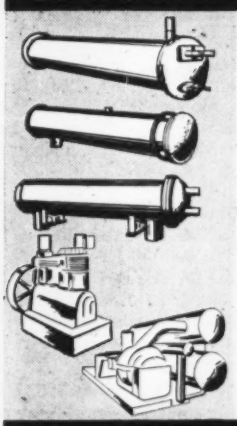
FOR BOILERS TO 35 HP AT 100 PSI

Permanent lubrication — sealed bearings
No bearing end play — preloading spring
Longer life — no metal to metal contact at impeller
Reduced packing maintenance — only one stuffing box
No internal corrosion — all bronze working parts
Long packing service — heavy duty stainless shaft
Easy access to liquid end
Mechanical seals optional equipment

Write for catalog section 151 covering the 0100 series pumps now

ROY E. ROTH COMPANY
2484 4th Ave. ROCK ISLAND, ILLINOIS

QUICK - PROMPT
RETUBING SERVICE



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CONDENSERS AND
COOLERS
—ANY CAPACITY.
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BOILERS
HEAT EXCHANGERS OR
ANYTHING WITH TUBES

Reconditioning and
Overhauling Centrifugal
and Reciprocating Pumps
Centrifugal and
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THE MAINTENANCE DEPARTMENT
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HOW DO YOU PREVENT

Tube Collapse due to Frosting?

Tube collapse from frosting is no threat when you use UNIFLARE fittings. Here's why—

UNIFLARE produces an inverted-type flare. The thread on the nut is *tapered* toward the wrench end. The tubing *expands* behind the nut during makeup, and a special *waxing* compound on the nut makes a water-resistant seal between nut and tubing.

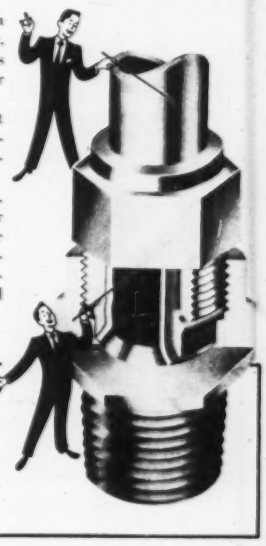
No case of tube collapse with UNIFLARE has ever occurred!

Uniflare RESISTS
BOTH FROSTING AND VIBRATION

Because there's no need of a *short* nut to minimize frosting, the long UNIFLARE nut gives more tube support and greater vibration resistance.

Bodies are *forged* to prevent season cracking, but are available for less severe service machined from bar stock.

With all these advantages, prices are still competitive. For all standard shapes in a wide range of sizes, see your distributor, or write SCOVILL MANUFACTURING COMPANY, 54 Mill Street, Waterbury, Conn.



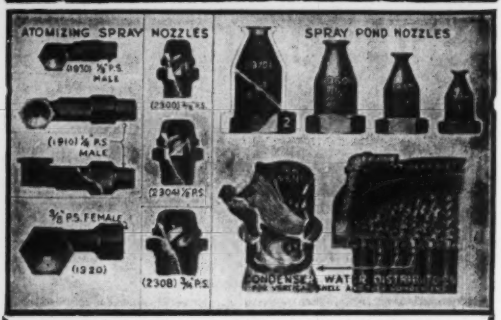
Only two parts, body and nut. Turning the nut makes flared, leakproof seal—no pre-flaring needed. Can be taken apart and reassembled many times without weakening seal.

FULLY TESTED AND APPROVED BY THE UNDERWRITERS' LABORATORIES, INC.

Uniflare THE COMPLETE SELF-FLARING TUBE FITTING

SCOVILL

QUALITY always wins!
MARTOCELLO Products are fully DEPENDABLE



ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, AND CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their manpower problem because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

Prompt Shipment From Stock

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Multi-Fin air cooled unit

COOLING TOWERS
WOOD TANKS
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MULTI-FIN UNITS

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Branches: New York, Boston, Chicago, Tulsa, Houston, San Francisco

HPAC 7540—CENTRIFUGAL FIRE PUMPS—Two basic types of centrifugal fire pumps, together with selection charts, information on necessary fittings, and application data are described and illustrated in Bulletin B-1500 of Peerless Pump Div., Food Machinery and Chemical Corp., 301 West Ave. 26, Los Angeles 31. Both single and two stage units, their methods of drive, and application are covered.

HPAC 7541—CONTROL OF HUMIDITY—Equipment for the "controlled humidity method" of air conditioning of Niagara Blower Co., 405 Lexington Ave., New York 17, is briefly described and illustrated in Bulletin 112. The use of "Hygrol" absorbent liquid is explained by means of a colored diagram.

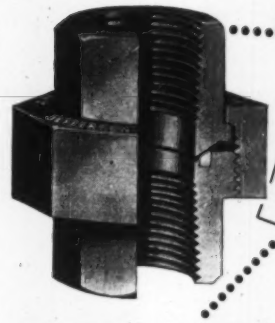
HPAC 7542—CONTROL VALVES—Automatic pressure, flow, and liquid level controls for steam, gas, air, water, oil and other fluids are described and illustrated in a condensed catalog (No. A-50) of Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago. The six bulletins comprising the catalog give detailed information on pressure regulators; altitude valves; pump governors; strainers; lever, float, and motor operated valves; pilot valves; back pressure, relief, and nonreturn valves; steam traps and air vents; liquid level controllers; solenoid valves; and the "Dia-Ball" transmission unit for liquid level controllers and control valves.

HPAC 7543—ELECTRIC MOTOR LUBRICATION—The Vol. 36, No. 1 issue of the house organ published by The Texas Co., 135 E. 42nd St., New York 17, is devoted to the lubrication of electric motors. Leading off with a brief discussion of factors which affect the selection of motors, the article deals with types of bearings, oil grooving, lubrication procedure, type of grease, and cleaning and flushing. The advantages of a regular schedule for relubrication are stressed.

HPAC 7544—GAS BURNERS—Proof of the Pudding is the title of a booklet on commercial gas burners of Iron Fireman Mfg. Co., 3170 W. 106th St., Cleveland 11. Ten installations are briefly described and illustrated and testimonial letters from users are presented. Some of the installations shown are arranged for various combinations of coal, gas, and oil firing.

HPAC 7545—GLASS FIBER INSULATIONS—Describing all forms of "Fiberglas" thermal insulations, a new 16 page booklet has been released by Owens-Corning Fiberglas Corp., Toledo 1, Ohio. Covering industrial and building applications, the booklet gives data on thermal conductivity and sound absorption properties and is illustrated with numerous application photographs.

HPAC 7546—HEAT EXCHANGER—"Everclean Paracoils" are described by Davis Engineering Corp., 1064 E. Grand St., Elizabeth, N. J., as heat exchangers which are automatically cleaned at predetermined intervals. Bulletin 190 covers the application of this type exchanger as a white water heater, a process requirement of the paper making industry. The heater is said to apply with equal value to any process where surface fouling may exist. The bulletin is illustrated as to assembly and details and



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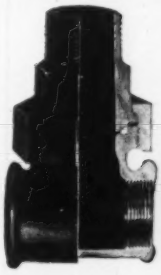
Close fits are simple with Jefferson Unions . . . and once in they'll STAY in because we make them from a very fine malleable iron with a tensile strength of 55,000 lbs per sq in. Details such as the machining instead of casting the ring channels . . . making the rings from special tubing instead of casting them and testing all fittings with air before delivery all add up to a minimum of maintenance after the installation. You're sure the job's in to stay when the joints are made with Jefferson Specialty Unions.



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607 West 26th Street, New York 1, N. Y.
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65 Gooding Street, Lockport, N. Y.

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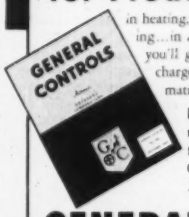
for Product or Process...



in heating, refrigeration, aircraft or industrial processing...in *any* application where CONTROL is *vital*, you'll get better results with General Controls in charge. Whatever the *need*, for the best in automatic controls, it's General Controls.

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Manufacturers of Automatic Pressure, Temperature, Level & Flow Controls
FACTORY BRANCHES: Baltimore 5, Birmingham 3, Boston 16, Buffalo 3, Chicago 5, Cincinnati 2, Cleveland 15, Dallas 1, Denver 4, Detroit 8, Glendale 1, Houston 6, Kansas City 2, Minneapolis 2, New York 17, Philadelphia 40, Pittsburgh 22, San Francisco 7, Seattle 1, St. Louis 12, Tulsa 6.
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AIR-FLO

AUTOMATIC

CEILING SHUTTER

FOR ATTIC FAN

Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 5 different widths, single panel up to 78" long. No operating mechanism shows. Built-in fusible link. Meets fire underwriters requirements.

WRITE FOR NEW CATALOG 43-D

Illustrations and details of the complete AIR-FLO line.

AIR CONDITIONING PRODUCTS CO.
2340 W. LAFAYETTE BLVD. · DETROIT 16, MICH.

GREAT NEWS FOR CONTRACTORS...

THE POWDER-ACTUATED FASTENING TOOL *Comes of Age*

After months of Laboratory Experimentation... After Thorough "On-the-Job" Testing... We Proudly Present the New and Amazing DRIVE-IT "300" the Powder-Actuated Fastening Tool Our Customers Asked For.

THE BIRTH OF THE DRIVE-IT IDEA . . . Three years ago Powder Power introduced DRIVE-IT the powder-actuated tool . . . a tool that utilized a small power charge and a hardened steel "drive-pin" to fasten steel or wood to concrete or steel. Fastening with this tool was a split-second operation—eliminating the drudgery of drilling or hammering and saving contractors hours of time and thousands of dollars.

PRESENTING...THE NEW DRIVE-IT "300"...Today we proudly present a *new* and *better* powder-actuated tool . . . one which embodies all of the features our customers asked for. It's the DRIVE-IT "300" and it's ready for you NOW. Check these features and you'll realize why we say: "The new DRIVE-IT "300" is the *only* truly modern, efficient and *safe* powder-actuated tool on the market!"

POSITIVE 3-WAY SAFETY. Permanently attached, adjustable safety pad.

"CONTROLLED POWER" with *one* power charge.

LIGHTWEIGHT. Tool weighs only 5 lbs., 10 ozs. Makes work easy.

LESS NOISE. Tool is much quieter in operation.

40% MORE POWERFUL than any other "22".

AUTOMATIC EXTENSION BARREL for tight places.

FLANGELESS DRIVE PINS. Easier to handle — cheaper to buy.

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POWDER POWER TOOL CORPORATION
0715 S. W. Woods Street, Portland 1, Oregon

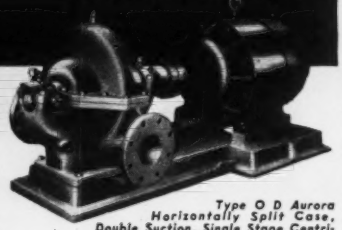
Canadian Distributors: AMMO-POWER TOOL CO., LTD., Foot of McLean Drive, Vancouver, B. C., Canada

INTEGRITY *Counts in* **PUMPS,** *too*

This Truly Great AURORA TYPE O D CENTRIFUGAL PUMP

for general water supply, for municipalities, industrial establishments.

also for handling condenser circulating water, wash water, liquids in paper mills and distilleries, chemical solutions, oils in oil fields and refineries, irrigation, etc.



Type O D Aurora Horizontally Split Case, Double Suction, Single Stage Centrifugal Pump.

The ultimate in design and perfection—type O D pumps—in capacities to 4,000 G.P.M. and heads to 300 ft.—are accessible, compact and lasting. The horizontally split-case type of design permits removal of upper half of casing without disturbing suction or discharge. The impellers and water channels are streamline designed to minimize flow resistance and avoid turbulence, cavitation and consequent corrosion and erosion.

Write for CONDENSED CATALOG "M" and O D Bulletin 105

APCO TURBINE-TYPE PUMPS

For high pressure, Small capacity requirements (up to 150 G.P.M.). Wide operating range characteristics. No metal to metal contacts. Handles non-lubricating liquids without wear. Only one moving part — the Impeller.

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80 Loucks Street, AURORA, ILLINOIS

For Domestic & Industrial use

EXTREMELY ACCURATE, SENSITIVE HEATING, COOLING & PRESSURE CONTROLS

TYPE U—Room Type Thermostat for Domestic Installations is an adjustable control calibrated from 54° to 84° F, 75° to 105° F or 30° F to 60° F. Differential is fixed 2° F. Electrical rating 15 amps 125/250 V AC. Also offered with tamper proof cover for industrial installation.

TYPE W—Remote Bulb Type Thermostat for highly accurate controls, over short ranges, of ovens, incubators, water baths, etc. Adjustable either with calibrated dial or by screw driver. Selected short ranges F between limits of −120°F and 600°F. Electrical ratings 125/250 V AC.

TYPE LR—A highly sensitive pressure-vacuum control offering very close differentials of from 6" wc to 1½ psi. Controls are adjustable over varying ranges between limits of 0 to 180 psi and 30" hg vac to 0. Rated electrically at 125/250 V AC.

UNITED ELECTRIC CONTROLS COMPANY

87 School Street
Watertown, Mass.

Whatever your control problem may be United Electric Controls Co. is prepared to assist you. Send full details and drawings. Write for bulletins giving complete details on the controls mentioned above.

STANDARD & SPECIAL THERMOSTATS & PRESSURE SWITCHES

also contains a table of dimensions and sizes. Illustrations show how the fluid passes through the shell of the exchanger and how the flow is directed by cross baffles which double as tube cleaners.

HPAC 7547—HEAT TRANSFER EQUIPMENT—Features of "Reco" storage type water heaters, instantaneous heaters, and heat reclaimers are set forth in Catalog 501 of Richmond Engineering Co., Inc., 7th and Hospital Sts., Richmond, Va. Information is given on uses, construction, testing, capacities, and dimensions. Design data are also included.

HPAC 7548—HEATING BOILER—The 200 series boilers in types A and H, of National Radiator Co., Johnstown, Pa., are covered in Catalog No. 562. Dimensions, IBR ratings, and other pertinent data are given on these boilers which are designed for use with either steam or hot water and which are completely equipped for hand firing. Recommended for small commercial buildings, they may be converted to automatic firing.

HPAC 7549—HEATING, CONDITIONING EQUIPMENT—Over 1000 unit heaters of Modine Mfg. Co., Racine, Wis., are used in plants of a well known supplier to the automotive industry. The location and arrangement of heaters are briefly described in the Vol. 13, No. 2 issue of the firm's house organ. Also mentioned is the use of the company's heating and cooling coils in two theaters.

HPAC 7550—INDUSTRIAL SPRAY NOZZLES—Bulletin 20 of Binks Mfg. Co., 3122 Carroll Ave., Chicago 12, covers a new line of industrial spray nozzles, which are machined from brass but are also available in steel, stainless steel, monel, and other metals. Information on spray angles, orifice diameters, and pipe sizes are given and capacity data are tabulated.

HPAC 7551—LIQUID COOLER—The packaged liquid cooler of Doyle & Roth Mfg. Co., 136-50 24th St., Brooklyn 32, includes a refrigeration compressor, motor and starter, controls, liquid cooler, condenser, piping, wiring, and insulation. It is available in sizes from 5 to 100 tons and is described in a new four page bulletin.

HPAC 7552—LIQUID LEVEL INSTRUMENTS—A new 24 page illustrated catalog (No. 75) describes "Levelimeter" instruments manufactured by Fischer & Porter Co., Hatboro, Pa. Instruments are designed to indicate, measure, and control liquid level and inter-face level. Described are magnetic tape-and-drum, electronically transmitting, ball float, pneumatic, and differential pressure units; v notch weir and Parshall flume flowmeter instruments; and chemical service sight gage glasses.

HPAC 7553—PROTECTIVE COATING—Dampney Co. of America, Hyde Park, Boston 36, has developed silicone coating aluminum for weather-exposed service at temperatures up to 750 F. The new protective coating, applied by brush or spray, is formulated to withstand either continuous exposure to heat or intermittent heating and chilling, all conditions of weather exposure, and chemical fume attack. The coating is described in Bulletin 1570.

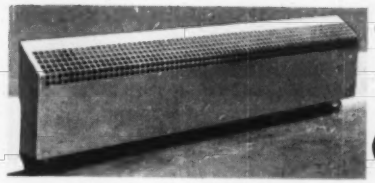
Easiest to-

SELL

BECAUSE THEY'RE EASIEST TO INSTALL

REMPE

CONVECTORS



FOR NEW CONSTRUCTION OR REPLACEMENT OF CAST-IRON RADIATORS

HEAT TRANSFER EQUIPMENT REMPE CO. Founded 1890

ATTRACTIVE MODERN EFFICIENT

Easy to install above or in baseboard. Occupy little space—3" deep by 8" high. Gives better distribution of warm air.

Rempe Fin Tube Convectors have a heavy gauge steel slanted cover —won't collect dust. Greater BTU capacity. EDR capacity 4.75 per lineal foot of casing length.

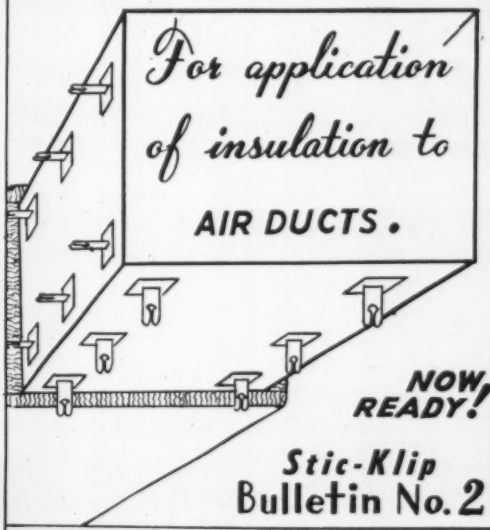
Write for bulletin and prices. Territories Open.

REMPE CO.

342 No. Sacramento Blvd., Chicago

Pipe and Fin Coils for Refrigeration and Air Conditioning

Stic-Klip For Insulation Installation



Stic-Klip Bulletin No. 2

Stic-Klip MANUFACTURING COMPANY 30 REGENT STREET CAMBRIDGE 40, MASS.

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Just Specify → B&J

That's what leading Architects & Engineers do when they want the best in Steam Traps. They know the Barnes & Jones reputation for building years of top performance into its products.

Whether the call is for Low Pressure Thermostatic Traps for radiator or convector returns; Medium and High Pressure Thermostatic Traps for cooking apparatus or process fixtures; or Float & Thermostatic Traps for drips; Barnes & Jones has the answer in a quality product. "The Right Trap for the Right Job".

Original installation of Barnes & Jones traps cures the maintenance man's headache before it begins. Only the element and seat ever wear out and these, because of the unique construction, are simplicity itself to replace.

Send for Catalog No. 76 today!

Barnes & Jones Inc.

128 Brookside Avenue

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Radiator Valves

F & T Traps

Thermostatic Traps

Boiler Return Traps

***It's* PORTABLE!**

HAYS GAS ANALYZER

The Hays gas analyzer (or Orsat) tells if oil burner or stoker is properly installed—or if combustion is at maximum efficiency. Gives *accurate* readings of draft, CO_2 and flue gas temperature. Available in several styles from the single to the multiple chamber model shown which analyzes CO_2, O_2 and CO. All sizes available from stock. Write for helpful literature . . . FREE!

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Since 1901 COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROL

MICHIGAN CITY, INDIANA, U.S.A.

bend pipe by hand or power with
"American"
cold pipe, conduit and heavy wall tube
BENDING MACHINES
Fast...
Simple...
Dependable...

RADIANT HEAT BENDS
in Standard Pipe

Fast . . . Accurate . . . Average bend takes only 60 seconds! Up to 180° bends . . . all sizes from ½" to 2". Usual radiant heat bends for 1¼" at 6" and 9" radii can be supplied. Only 7 parts. Occupies 18" x 18" floor space.

Hand-Powered
"American" A-30

Capacity ½" to 2" standard pipe . . . Minimum radius 5 times pipe diameter up to 180° . . . Maximum radius 13". Complete with rolls for each size pipe. Standard motor equipment 2 h.p.

Special radii supplied on request.

Motor-Powered
"American" 2PB

"American"
PIPE BENDING MACHINE
Company INC

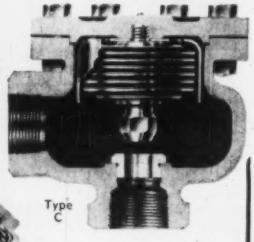
Factory and Main Offices: 17 Furnace St., Poultney, Vt.

Leading Processor

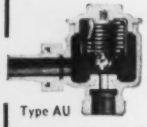
Shortens Operation from 65 to 45 Min.

with Nicholson
STEAM TRAPS

Records of a recent installation of Nicholson steam traps, by a large food packer, show they cut cooking time



Type C



Type AU

Type AHV

30%; e. g., one operation was shortened from 65 to 45 min. Nicholson units keep equipment full of live steam because: 1) they operate on lowest temperature differential; 2) have 2 to 6 times average drainage capacity. Also record low for steam waste; and maximum air-venting capacity. Widely specified for preventing damage to thin gauges of heat transfer units; eliminate cold blow in unit heaters. 5 types for every application; size ¼" to 2"; press. to 225 lbs. BULLETIN 1047.

W. H. NICHOLSON & CO. 198 OREGON ST. WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

HPAC 7554—PUMPS—A new booklet prepared by Deming Co., Salem, Ohio, covers the main events in the 70 years' history of the firm. Among the numerous photos are present officers, directors, department heads, sales and advertising men, and the honor roll of 25-year employees. Manufacturing facilities and installations of the company's pumps and water systems are illustrated.

HPAC 7555—QUICK OPERATING VALVES—Bulletin E-160 on quick operating valves for general services has been released by Everlasting Valve Co., 49 Fisk St., Jersey City 5, N. J. Design and construction features are covered, as are applications to blow-off service and uses with fire protection, chemical process, soot blower, water column blow-down, and other types of pipe lines.

HPAC 7556—REFRIGERATION EQUIPMENT—Some of the refrigerating, and air conditioning equipment and services available from Frick Co,, Waynesboro, Pa., are illustrated and briefly mentioned in Bulletin 195-A. Compressors, coils, water coolers, condensers, conditioners, valves, and fittings are but a few of the many items shown in the booklet.

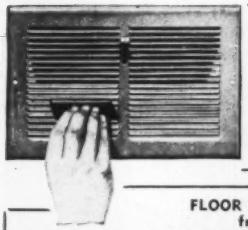
HPAC 7557—REFRIGERATION SPECIALTIES—McIntire Connector Co., 263 Jefferson St., Newark 5, N. J., has released Catalog R-8 showing dimensions, ratings, and parts on its latest line of DPN refrigeration dryers, filters, strainers, moisture indicators, moisture control units, and large dryers up to 100 tons capacity.

HPAC 7558—RUBBER LINED PIPE, FITTINGS—A new 8 page catalog section on its rubber lined pipe, fittings, and valves has been issued by B. F. Goodrich Co., Akron, Ohio. Details of design, construction and service recommendations are given. Applications are described and illustrated.

HPAC 7559—RUBBER PANEL HEATING UNITS—A new bulletin on the embedded wire resistor type of electrically heated rubber has been issued by B. F. Goodrich Co., Akron, Ohio. It contains information designed to answer such questions as: what is electrically heated rubber, on what voltage does it operate, how much power can be put into heated rubber, what are the available sizes and shapes, what are the advantages, and how much does it cost.

HPAC 7560—SCALE, CORROSION PREVENTION—A recently published technical folder regarding the use of anti-precipitating agents is now available from Power Chemicals Div., E. F. Drew & Co., Inc., 15 E. 26th St., New York 10. The folder describes the use of anti-precipitating agents for the prevention of scale and corrosion in cooling systems, service water lines, heat exchangers, and other process equipment.

HPAC 7561—SPEED REDUCERS—Bulletin 1110 of Falk Corp., Milwaukee 8, is an improved engineering bulletin designed to provide complete data on the company's parallel shaft, sleeve bearing speed reducers. According to the firm, engineering data have been condensed into one booklet and at a later date separate sales bulletins will be issued.



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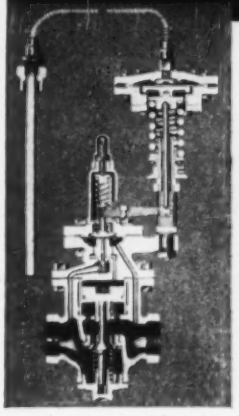

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HPAC 7562—STAINLESS STEEL CONDENSERS—Doyle & Roth Mfg. Co., 136-50 24th St., Brooklyn 32, has published a four page booklet on its stainless steel vapor condenser model VT. A diagram, specifications, overall dimensions, design and test pressures, and list prices are given.

HPAC 7563—TEMPERATURE REGULATORS—A new six page folder describing the construction and operation of the type E2T100 temperature regulator is available from Spence Engineering Co., Inc., Walden, N. Y. The folder contains illustrations showing how the regulator is adapted for use with storage heaters and instantaneous heaters because it is designed to vary steam pressure in definite steps with small temperature changes.

Gives Data on Refrigeration Controls

A paper on refrigeration controls by William P. Myers, Jr., application engineer, Alco Valve Co., provides information on the construction and application of different types of valves and switches used for refrigerant control.

Briefly covered are the function and operation of automatic expansion valves, thermostatic expansion valves, high side and low side float valves, float switches, evaporator pressure regulators, liquid and suction stop valves, and injectors and pumps.

Identified as application data pamphlet No. 47, the paper is available from the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18, for 45 cents.

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Development engineer as assistant to Chief Engineer experienced in the design, production and testing of Gas and Oil Fired Forced Warm Air Furnaces. Write for interview and include a resume of your work for the past ten years; General employment information, references, small photograph and compensation expected. COLUMBIA SPECIALTY COMPANY, Inc., 503 Bradley Blvd., Chevy Chase, Maryland.

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REFRIGERATION SALES PROMOTION opening—Manufacturer of heating and air conditioning equipment has excellent opening for man experienced in promoting sales of refrigeration for air conditioning and process application. Reciprocating units to 75 tons, centrifugals 50 tons and up. No refrigerators or walk-in boxes involved. Permanent location west central Wisconsin. All replies confidential. Address Key #843-A, Heating, Piping & Air Conditioning, 6 No. Michigan Avenue, Chicago 2.

Wanted by Mechanical Contractor — Vicinity Washington, D.C. Estimator for Plumbing, Heating and Ventilating Systems. Must be able to also handle Purchasing. State Salary, Experience and References. Desire a permanent Employee. Address Key #838-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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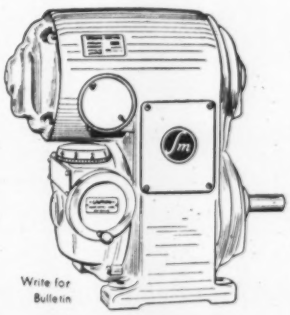

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INDEX TO ADVERTISERS

Acme Industries, Inc. 186
Aerofin Corp. *
Air Conditioning Products Co. 181
Air Devices, Inc. 186
Air Filter Corp. 176
A-J Mfg. Co. *
Air-Maze Corp. *
Airtemp Div. of Chrysler Corp. 157
Airtherm Mfg. Co. 148
Alco Valve Co. 152
Aldrich Co. *
Allen-Bradley Co. *
Alliance Mfg. Co. *
Allis-Chalmers Mfg. Co. 6, 28 & 38
American Air Filter Co., The 155
American Blower Corp. 35
American Brass Corp., The 47
American Chain & Cable Co., The *
American District Steam Co. *
American Instrument Co. 170
American Pipe Bending Machine Co., Inc. 184
American Radiator & Standard Sanitary Corp. *
Ames Iron Works *
Anderson Co., V. D. *
Anemostat Corp. of America *
Armstrong Cork Co. 31
Armstrong Machine Works *
Auer Register Co. 50
Aurora Pump Co. 182
Autempco Corp. 186
Auto Radiator Specialty Co. 161
Automatic Switch Co. 173

Badger Manufacturing Co. 164
Baldor Electric Co. *
Baltimore Aircoil Co. *
Barber-Colman Co. 46
Barnes & Jones, Inc. 183
Bauer & Black Div. of Kendall Co. *
Bell & Gossett Co. 19 & 45
Binks Mfg. Co. 168
Bishop & Babcock Mfg. Co., The *
Black & Decker Mfg. Co. 167
Blackhawk Mfg. Co. 185
Bonney Forge & Tool Works *
Breidert Co., G. C. *
Brownell Co., The *
Brundage Co. *
Brunner Mfg. Co. 14
Buffalo Forge Co. 40
Buffalo Pumps, Inc. 49
Bundy Tubing Co. *
Bush Mfg. Co. *
Byers Co., A. M. 4

Campbell Heating Co. *
Carey Mfg. Co., The Philip 171
Carnegie-Illinois Steel Corp. 18
Carrier Corp. 53
Cash Co., A. W. *
Century Electric Co. *
Chicago Pump Co. *
Clarage Fan Co. Inside Back Cover
Cleaver-Brooks Co. *
Columbia Steel Co. 18
Combustion Control Corp. *
Combustion Engineering—Superheater Inc. *
Committee on Steel Pipe Research of American Iron & Steel Institute 143
Condenser Service & Engineering Co. 179
Connor Engrg. Co., W. B. 11 & 37
Continental Air Filters, Inc. *
Cork Import Corp. *
Couplings Co., The *
Crane Co. 64
Curtis Refrigerating Machine Co. *

Davis Engineering Corp. *
De Bothezat Fans Division American Machine & Metals, Inc. 160
Delco Motors Div. of General Motors Corp. *
Detroit Lubricator Company 27
Detroit Stoker Co. *
Dodge Mfg. Co. *
Dollinger Corp. *
Dole Valve Co., The *
Dravo Corporation 8
Dunham Co., C. A. *
Durant Insulated Pipe Co. *
Duriron Co., Inc., The *
Dutton Company, C. H., Inc. 185

Eagan Co., Walter H. *
Eclipse-Pioneer Div. Bendix Aviation Corp. *
Economy Pumps, Inc. 165
Elco Tool & Screw Corp. 153
Emerson Elec. Mfg. Co. 145
Enterprise Engine & Foundry Co. *

Fairbanks Co. *
Farr Co. 7
Fedders-Quigan Corp. 42
Fisher Governor Co. *
Fitzgibbons Boiler Co., Inc. *
Foster Wheeler Corp. *
Frick Co. *
Friez Instrument Div. of Bendix Aviation Corp. 174
Fulton Sylphon Co. *

G. & O. Mfg. Co., The *
Gallaher Co. *
Gardner-Denver Co. 36
General Automatic Products Corp. 159
General Blower Co. *
General Controls Co. 181
General Fittings Co. *
General Gas Light Co. *
Glasfloss Corp., The *
Globe Steel Tubes Co. 140
Gold Top Heating, Inc. *
Governair Corp. *
Greenlee Tool Co. *
Grinnell Co., Inc. Inside Front Cover

H & H Tube and Mfg. Co. 62
Haines & Co., William S. *
Hajoca Corporation *
Hamilton-Thomas Corp. 165
Handy & Harman 139
Haney Gas Burners & Engineers *
Hastings Instrument Co., Inc. *
Hayes Furnace & Mfg. Co., Inc. *
Hays Corp. 183
Hendrick Mfg. Co. 166
Hoffman Specialty Co. *
Howe Ice Machine Co. *
Howell Electric Motors Co. 34
Hussey & Co., C. G. 39

Ilg Electric Ventilating Co. *
Illinois Engineering Co. *
Illinois Testing Laboratories, Inc. *
Independent Register Co. 156
Infra Insulation, Inc. 137
Ingersoll-Rand 142
Iron Fireman Mfg. Co. *

Jan-Air, Inc. *
Jefferson Union Co., Inc. 181
Jenkins Bros. 150
Johns-Manville 175
Johnson Heater Corp. *
Johnson Service Co. *
Joy Mfg. Co. *

Kaiser Aluminum & Chemical Sales, Inc. 162
Kaylo Div., Owens-Illinois Glass Co. 141
Kennard Corp. *
Kennedy Valve Mfg. Co., The 177
Kewanee Boiler Corp. 56
Key Co. *
Klipfel Valves, Inc. *
Kritzer Radiant Coils, Inc. *

Ladish Co. 54 & 55
Lee Engineering Co. 163
Leslie Co. 185
Lilie-Hoffman Cooling Towers, Inc. *
Lincoln Electric Co., The *
Lunkenheimer Co., The *

Maid-O'-Mist, Inc. *
Marley Co., The 43
Marlo Coil Co. 33
Marsh Heating Equipment Co. *
Mortocello & Co., Jos. A. 180
McCord Corp. *
McDonnell & Miller, Inc. Outside Back Cover
Mercoid Corp., The *
Mettler Co., Lee B. *
Mid-States Welder Mfg. Co. *
Midwest Piping & Supply Co. *
Milton Equipment Co. 185
Minneapolis-Honeywell Regulator Co. 149
Miracle Adhesives Corp. *
Modine Mfg. Co. 24
Moore Company, The *
Mueller Furnace Co. *
Multi-Vent Div., Pyle National Co. *
Mundet Cork Corp. 146
Murray Mfg. Co., D. J. *

Nash Engineering Co. 72
Nelson Corp., Herman *
Nesbitt, J. 68
New York Blower Co., The *
Niagara Blower Co. *
Nicholson & Co., W. H. 184

Ohio Brass Co. 58 & 59
Ohio Injector Co. *
Olson & Company, Arthur A. *
Orr & Sembower Inc. *
Owens-Corning Fiberglas Corp. *

Patterson-Kelley Co., Inc., The 171
Penn Electric Switch Co. 144
Pittsburgh-Corning Corp. *
Porter & Co., H. W. *
Powder Power Tool Corp. 181
Powers Regulator Co., The *
Prat-Daniel Corp. *
Pritchard Co., J. F. *
Propellair, Inc. *

Randall Graphite Bearings, Inc. *
Reading, Pratt & Cady Div., American Chain & Cable Co., The *
Refrigeration Engineering, Inc. 52
Register & Grille Mfg. Co. *
Reinhard Brothers Co. 172
Rempe Co. 183
Republic Steel Corp. 57
Research Products Corp. 147
Revere Copper & Brass, Inc. 71
Ric-wil Co., The 22
Ridge Tool Co. 154
Rittling Corp. *
Rotary Concrete Drill Co. *
Roth Co., Roy E. 179
Russell Elec. Co. *

SKF Industries, Inc. *
Sall Mountain Co. *
Sante Fe Tank & Tower Co. 180
Sarco Co., Inc. 13
Sarcotherm Controls, Inc. 12
Scovill Mfg. Co. 179
Sellers Engineering Co. *
Skidmore Pumps *
Spang-Chalfant Div. of The National Supply Co. 25
Spence Engineering Co., Inc. *
Spencer Heater Div., Avco Mfg. Corp. *
Sporlan Valve Co. *
Spraying Systems Co. *
Standard Stamping & Perforating Co. 185
Stemco Corp. 173
Stephens-Adamson Mfg. Co. *
Sterling, Inc. *
Sterling Electric Motors 187
Stic-Klip Mfg. Co. 183
Strong, Carlisle & Hammond Co. *
Sturtevant Co., B. F., Div. of Westinghouse Elec. *
Super Radiator Corp. *
Superior Combustion Industries Inc. *
Surface Combustion Corp. 138
Swartwout Co. *
Syncromatic Corp. *

Taylor Forge & Pipe Works 21
Taylor Instrument Companies 63
Tennessee Coal, Iron & R. R. Co. 18
Thrush & Co., H. A. 29
Titus Mfg. Corp. 9
Titusville Iron Works Co., The, Div of Struthers Wells Corp. 169
Trane Co., The 20
Trion, Inc. 161
Tube Turns, Inc. *
Tuttle & Bailey, Inc. 32
Typhoon Air Conditioning Co., Inc. *

Unistrut Products Corp. 48
United Cooling Tower Co. *
United Conditioning Corp. *
United Electric Controls Co. 182
United States Air Conditioning Co. *
United States Steel Corp. 18
United States Steel Export Co. 18
United States Steel Supply Co. 18
Un-Right Scaffolds *
Utility Appliance Corp. 16 & 17

Vulcan Radiator Co. *

Wagner Electric Corp. 26
Walton Laboratories, Inc. *
Walworth Co. 23
Ward Leonard Elec. Co. *
Watson-Stillman Co. 15
Webster & Co., Warren 67
Webster Engineering Co., The *
Weil Pump Co. *
Weinman Pump Mfg. Co. 178
Welding Fittings Corp. *
Westinghouse Elec. Corp. 41
Wheatland Tube Co. *
Wheeler Mfg. Co., C. H. *
White-Rodgers Electric Co. *
Whitlock Mfg. Co. *
Whittington Pump & Engrg. Corp. *
Wiegand Co., Edwin L. 186
Wiley & Sons, Inc., John *
Wilson & Co. *
Wilson, Inc., Grant 61
Wing Mfg. Co., L. J. 60
Wolverine Tube Div. of Calumet & Hecla Consolidated Copper Corp. 51
Worthington Pump & Machinery Corp. 44

Yarnall-Waring Co. 158
York Corp. 10
Young Radiator Co. *
Youngstown Sheet & Tube Co. 30

Zallea Bros. *
Zink Co., John *
Zonolite Company *

Firms represented in this issue are identified by the folio of the page on which their advertising appears. Advertising which appears in other issues is marked with an asterisk.

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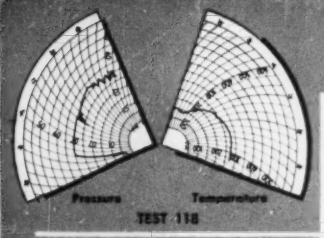
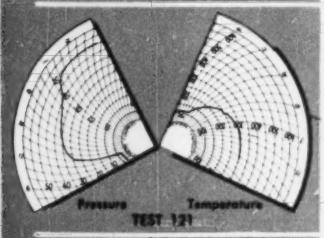
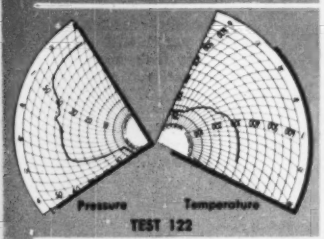


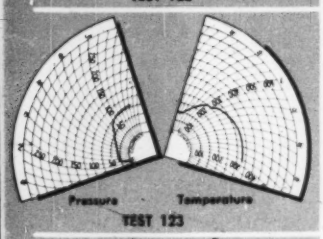
TEST 118



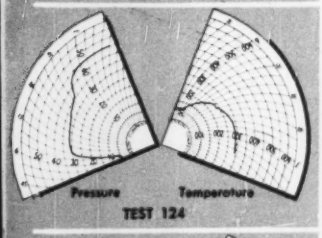
TEST 121



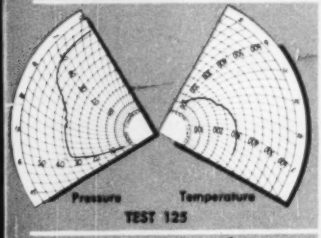
TEST 122



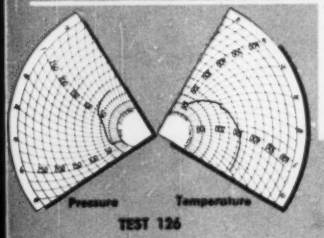
TEST 123



TEST 124



TEST 125



TEST 126

Here is the answer under actual operating conditions

That section of the current A.S.M.E. boiler code bearing directly on the testing and rating of relief valves for hot water heating boilers reads in part:

"Relief valves for hot-water boilers shall be tested for capacity at 10 per cent over the 30 psi required set pressure . . . These tests shall be conducted in the presence of, and certified by, an authorized observer . . . A data sheet for each valve tested shall be filled out and signed by the authorized observer . . . Such data sheet will be the manufacturer's authority to build and stamp valves of corresponding design and construction . . . The relieving capacity that may be stamped on the valves shall not exceed 90 per cent of the value determined by the witnessed tests."

However, despite this code recommendation, the question is still being asked: "Is a Btu. rated relief valve really necessary?" The test data shown and tabulated here prove that a Btu. rated relief valve is absolutely necessary to prevent over-pressure under *all conditions** that can arise in hot water heating boiler operation.

Why and how the test was made —

The purpose of this test was to compare the pressure (and temperature) developed in a boiler under the same operating conditions but with two kinds of valves:—

(1) Equipped with Btu. rated relief valves capable of dissipating the maximum heat output of the boiler.

(2) Equipped with non-rated relief valves.

For the rated valve test we chose the new McDonnell No. 33, which was tested by the National Board of Boiler and Pressure Vessel Inspectors to comply with the A.S.M.E. boiler code, and is rated (on its nameplate) at 242,900 Btu. per hour. The test on the No. 33 was made as severe as possible — at a boiler output of 243,000 Btu. per hour, its maximum rated capacity.

To make the non-rated valve test entirely representative we chose, not one, but several of the popular makes of non-rated valves. These were tested at the same heat output as the rated valve—243,000 Btu. per hour. All of these valves were purchased new from Chicago stocks during July of this year.

The recorder charts related to the test are reproduced opposite. Test and physical data are as follows:

(1) TEST OF RATED VALVE

Test No.	Manufacturer	Type No.	Test Data: Boiler Output Btu. per hr.	Test Data: Max. Pres. lbs.	Test Data: Max. Temp. Deg. F.	Physical Data: Inlet	Physical Data: Outlet	Physical Data: Orifice Diam.	Physical Data: Disc Material
118	McDonnell & Miller	No. 33	243,000	33	275	¾"	1"	7/16"	Metal

(2) TESTS OF NON-RATED VALVES

121	A	—	243,000	50	296	¾"	¾"	9/16"	Composition
122	B	—	243,000	50.5	297	½"	½"	7/16"	Composition
123	C	—	243,000	80	324	½"	½"	15/32"	Composition
124	E	—	243,000	45	290	½"	½"	7/16"	Composition
125	F	—	243,000	52	300	¾"	¾"	3/8"	Composition
126	D	—	243,000	76	321	½"	½"	15/32"	Composition

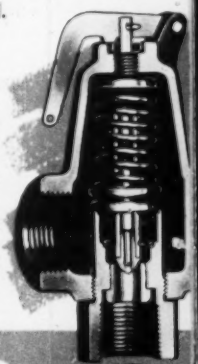
Yes, only the McDonnell No. 33 held pressure within the maximum of 33 psi covered by the A.S.M.E. Code (10% over the 30 psi required set pressure.) All others exceeded it; many of them far exceeded it.

An interesting side-light on the test is found in the fact that the McDonnell No. 33 is the first Btu. rated and labelled safety relief valve to be priced within the reach of every boiler owner. As the test shows, it will prevent over-pressure on any hot water boiler having a heat output equal to or less than its rated capacity of 242,900 Btu. per hour—approximately 70% of them according to I.B.R. records of 1948 boiler shipments.

Notice that despite its moderate price the No. 33 is the only valve tested having metal-to-metal seating.† This means leak-tight closure; freedom from deformation, sticking, etc. Other features are: two-stage discharge—low rate for thermal expansion; high rate for emergency; independent easy-to-lift testing lever; neat compact design. Ask for bulletin.

McDONNELL & MILLER, INC., 1316 Wrigley Bldg., Chicago 11, Ill.

Doing One Thing Well



McDONNELL NO. 33 SAFETY RELIEF VALVE

Yours Perfect Since Then

*Yes, *ALL* conditions. Good engineering accepts no unnecessary risks. Yet strangely enough, homeowners are often asked to run risks that industry, which follows code recommendations to the letter, would refuse to accept.

Obviously the code makers, in recommending rated relief valves for hot water heating boilers, proceeded on the only sound engineering basis of accepting no unnecessary risks. On this basis—on the basis of anticipating every possible emergency—the only means of preventing the over-pressure attendant to such an emergency is to provide a means of dissipating the maximum heat output of the boiler.

Make no mistake about it: This requirement can be fulfilled only by a Btu. rated relief valve properly matched to the boiler on which it is installed.

† In this connection it is interesting to note that a bulletin, dated April 30, 1948, and entitled "Hot Water Pressure Relief Device Test Conducted by the National Board of Boiler and Pressure Vessel Inspectors at Ohio State University" contains this significant paragraph:

"The fact that composition discs can become deformed or can change shape during tests introduces a variable in the opening area through a relief valve, making it practically impossible to measure the area of opening in a relief valve, which means that a coefficient of discharge as based on flow formula cannot be determined."